EXPERIMENT STATION
OF THE
HAWAIIAN SUGAR PLANTERS' ASSOCIATION

THE LEGUMINOUS PLANTS OF HAWAII

BEING AN ACCOUNT OF THE NATIVE, INTRODUCED AND NATURALIZED TREES, SHRUBS, VINES AND HERBS, BELONGING TO THE FAMILY LEGUMINOSAE.

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BY

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HONOLULU, HAWAII
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LETTER OF TRANSMITTAL

To the Experiment Station Committee of the
Hawaiian Sugar Planters' Association,
Honolulu, Hawaii.

DEAR SIRS:

I transmit herewith for publication a paper on "The Leguminous Plants of Hawaii," by Mr. J. F. Rock, of the College of Hawaii, and the Board of Agriculture and Forestry.

Respectfully,

H. P. AGEE,
Director.

PREFACE

The present paper is the outcome of a protracted study covering a period of ten years, and treats all the leguminous plants found in this Territory, either endemic, wild, and naturalized, as well as cultivated. Especial attention has been paid to the economic species, well known to agriculturists as nitrogen gatherers. Owing to the great number of species, the information is concise, and references are given to works where they are treated more exhaustively. The writer wishes to express his thanks to the Director of this Station for his interest and encouragement; also to Mr. E. M. Merrill, Botanist of the Bureau of Science, Manila, for advice; also to Dr. J. H. Maiden of Sydney, for the determination of Australian Acacias.

J. F. ROCK.

May 25, 1920.

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INTRODUCTION

This very large and distinct family is only sparingly represented in the Hawaiian Islands by endemic species, that is, species peculiar to the Hawaiian Islands. This fact is, however, outbalanced by the considerable number of species which have been more or less recently introduced into this Territory. Some have been brought to Hawaii in the very early days, as, for example, the now well established *Algaroba;* others have come in as accidental arrivals and have become pests. The larger number of ornamental trees introduced into Hawaii belong to this family. Of economic value there have been introduced numerous species, some of which are either now established or exist as single individuals, while others have been abandoned and are now not present in this Territory.

The species described in this paper are either all well established—and this includes, of course, the native species—or those on the way of becoming permanent inhabitants of this Territory.

Detailed descriptions and synonomy are given of all the native as well as established species, and mention is usually made only of the more recently introduced species of which young seedlings are at present still in nurseries or have been set out recently.

The nomenclature is in accordance with the laws of the last Botanical Congress and the earliest valid name has been accepted in all cases, with the exception of those covered by the *Nomina conservanda.* Notes on the economic values of species are, of course, more or less compilations from various works such as Watt's Economic Products of India, de Sorney's Green Manures and Green Manuring in the Tropics, etc.

Keys to the genera and species are to be found in their respective places.

No new species have been described, and only one or two new combinations have been made.

The percentage of indigenous species of *leguminosae* in the number here described is exceedingly small, and this points again to the truth of the assumption that these Islands were never connected with any continent, but that they have always been isolated. If we compare the number of Hawaiian species with those of the Philippine Islands, with 232 indigenous species, we realize at once the striking numerical difference in these two archipelagoes. When we examine the Hawaiian species again carefully we find that of the species only six species are trees and one is a shrub; while the remaining species with few exceptions are usually shore plants or grow in the vicinity of the shores and are distributed over most of the Pacific islands.

Advocators of a land connection with the Asiatic continent may well consider the number of *leguminosae* occurring on that continent as 1058 species in India, including the Malay Peninsula; Malay Archipelago 554 species, China 469 species, Formosa 136 species, and the Philippines with 285 species. Three of the six arborescent species occurring in Hawaii are Australian pure and

simple, with only a single species of that group in the Philippines and Formosa (*Acacia confusa*), while only one species is related to an Asiatic genus (*Mezoneurum*) and that species is vastly different from those occurring in tropical Asia. One other species of the six, (*Sophora*) is related to an American species (Chilenean) rather than Asiatic one, while *Erythrina* is represented by a single species which occurs also in the eastern Pacific and not in the western, nearest the Asiatic continent. Had these Islands been at any time connected with the Asiatic continent or Australasia, the number of *leguminosae* would certainly be larger, or at least preponderatingly Asiatic, but exactly the reverse is the case.

The Island of Juan Fernandez, with a flora similar to Hawaii, is another example of a purely oceanic island. There we find only one arborescent legume of the genus *Sophora* related to a Chilenean species.

As on other oceanic islands with no previous land connection, so in Hawaii is there an absence of *coniferae* and extreme poverty in Orchids, a family so marvelously developed in tropical Asia. The remaining genera of *leguminosae* in Hawaii owe their presence mainly to ocean currents or have belonged once upon a time to shore species with buoyant seeds, and we find these, or closely related species, widely distributed over the islands not only of the Pacific, but on islands situated in other oceans. Not a single one of the genera represented by numerous species in tropical Asia, as, for example, *Derris, Bauhinia, Pithecolobium, Albizzia, Indigofera, Desmodium, Crotalaria, Dalbergia*, etc., are represented in Hawaii, and these not even by related genera. If this does not point to an utter isolation of these Islands it is indeed difficult to point to a better example.

The number of genera belonging to other families, present in Hawaii, and of Malayan origin, consist usually of only one or rarely more than two species and are to the writer's mind no proof of a previous land connection, but rather that they represent chance arrivals during a long period. Where are the numerous species of *Eugenia*? Where is the genus *Ficus*; the *Dipterocarpaceae, Meliaceae, Burseraceae, Tiliaceae, Sterculiaceae, Myristicaceae, Melastomaceae, Anonaceae, Zingiberaceae, Casuarinaceae, Araceae, Palmae*,* *Asclepiadaceae, Combretaceae*, and others of which these Islands do not possess a single species, while we possess representatives of families like the *Geraniaceae*, which are poorly represented in tropical Asia.

That the plants of American affinities in Hawaii are much older than those of Malayan origin is proven by the numerous species in each genus or family as *Compositae, Lobeliaceae, Geraniaceae*, etc. The *Piperaceae*, for example, are represented in tropical Asia, mostly by numerous species of the genus *Piper*, while the genus *Peperomia* is very poorly represented. In Hawaii we have not a single indigenous species of *Piper*, but we do have more than 72 species of *Peperomia*.

All this proves conclusively that these Islands are purely oceanic and that at no time were they connected with the Asiatic continent or Australasia, and any entomologist familiar with Hawaiian insects can prove this by the fauna. Had

*Excepting the single genus **Pritchardia**.

Hawaii been at all connected with a continent we undoubtedly would have some mammals in our forests, but not even a reptile is indigenous or native in Hawaii.

To the writer's mind the *leguminosae* are a strong factor in the proving of the assumption that the Hawaiian Islands are purely oceanic in character. The writer is preparing a work on the Phytogeography of Hawaii, and he reserves the thorough discussion on the origin of the Hawaiian Flora and its affinities for that work, wherein it will take a prominent place.

For a discussion on the origin and relationship of the arborescent species of Hawaiian *leguminosae*, the writer would refer the reader, student or investigator to Botanical Bulletin No. 5 of the Hawaiian Board of Agriculture and Forestry, entitled "The Arborescent Indigenous Legumes of Hawaii," by Joseph F. Rock, June, 1919.

Undoubtedly there still occur a number of species of *leguminosae* in these Islands not listed in this paper. The writer has searched Honolulu carefully for species, as well as the mountains of all the islands, and nearly all the plants described in this paper are represented by herbarium specimens in the College of Hawaii Herbarium.

Nearly all the work in arranging this manuscript has been done in the writer's leisure hours. Hillebrand, in his excellent Flora of the Hawaiian Islands, mentions a number of introduced *leguminosae* which cannot be found now in this Territory. The following are enumerated by him: *Bauhinia diphylla, Hymenaea Courbaril, Caesalpinia Gillessii, Caesalpinia Mexicana, Cassia viminea, Cassia auriculata, Cassia Parahyba,* Cassia marginata, Acacia lophanta, Acacia pennata* and *Dichrostachys cinerea*.

All these species credited as occurring in Hawaii have been omitted, as they are not represented by living material.

A great many species have been introduced by the Hawaiian Sugar Planters' Association for experimental purposes, and such as are still in cultivation are here described; the abandoned species have been omitted. Species have also been tried and experimented with at the U. S. Agricultural Experiment Station at Honolulu, and data regarding the same may be found in their bulletins.

There are in all described in this paper 71 genera and 200 species.

Of the following genera, species have been introduced from time to time, but no living specimens are now extant: *Piptanthus, Templetonia, Hardenbergia, Lupinus, Spartium, Genista, Lotus, Milletia, Robinia* (of this genus, *R. pseudacacia* has lately been planted out in the lower hills), *Swainsonia, Astragalus, Onobrychis, Ormosia*, and probably others. During the writer's recent journey through Siam, Malay and Java, he collected and introduced seeds of a number of species of *leguminosae*, which have been planted, and so far the following have already germinated: *Hymenaea curbaril, Brownea coccinea, Albizzia minahassae, Albizzia montana, Sindora* sp.?, *Pithecolobium* sp.?, *Caesalpinia* sp.?, and *Thephrosia candida*.

The photographs were all taken by the author, either of living material or of specimens in the College of Hawaii Herbarium.

JOSEPH F. ROCK.

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*This is a synonym of **Schizolobium excelsum** recently introduced by the writer.

23 NOV 1920
AGRI. COIMBATORE

LEGUMINOSAE.

KEY TO THE SUBFAMILIES.

Petals valvate; flowers regular ... **Mimosoideae**
Petals imbricate: flowers irregular.
  Flowers not papilionaceous, the upper petal interior ... **Caesalpinioideae**
  Flowers papilionaceous, the upper petal (standard) exterior ... **Papilionatae**

MIMOSOIDEAE.

Flowers actinomorphic, usually pentamerous (rarely 3-, 4- or 6-merous); calyx 5-toothed or lobed, rarely divided to the base, the segments valvate with the exception of *Parkieae* (imbricate); petals as many as sepals, valvate, free or partly united; *stamens as many or twice as many as petals or many, free or* united into a tube or united at the base with the corolla-tube; anthers small, longitudinally dehiscing; ovary free in the base of the calycine tube.—Trees, shrubs more rarely herbs with bipinnate, rarely pinnate leaves and usually small flowers, arranged in heads, cylindrical catkins, or slender racemes; bracts small, narrow, usually *not present at anthesis; stamens usually exserted; funis* often developed into an arillus.

The subfamily *Mimosoideae* is represented in the Hawaiian Islands by 14 genera, and possibly 36 species, of which three only are endemic; the others represent more or less recent introductions.

KEY TO THE GENERA.

Calyx lobes valvate.
  Stamens many, at least more than 10 or more than twice the number of petals.
    Filaments more or less connate.
      Endocarp not distinct from the pericarp and not forming individual envelopes about the seed.
        Pods indehiscent, septate between the seeds.
          Pod snail-like semicircular or reniform woody ... **Enterolobium**
          Pod spongy or fleshy, straight, the sutures thickened: petals connate below into a tube ... **Samanea**
        Pods dehiscent or indehiscent, not septate between the seeds.
          Pods very strongly curved or twisted ... **Pithecolobium**
          Pods straight or slightly curved.
            Pods flat, thin, indehiscent or dehiscing with the valves remaining straight ... **Albizzia**
            Pods with thickened sutures, slightly curved dehiscing elastically from the apex to the base ... **Calliandra**
      Endocarp distinct and free from the pericarp, the latter not septate, the former septate between the seeds and forming an individual envelope about each seed ... **Wallaceodendron**
    Stamens free, inflorescence capitate ... **Acacia**
  Stamens as many as or double the number of petals.
    Anthers not gland-tipped.
      Pods straight, dehiscing through the sutures.
        Pod narrow-linear, seeds vertically or obliquely placed ... **Desmanthus**
        Pod broad-linear, seeds transversely placed ... **Leucaena**
      Pods slightly curved or nearly straight, somewhat aculeate, with always persistent, indehiscent sutures ... **Mimosa**
    Anthers gland-tipped.
      Seeds albuminous, erect trees.
        Spiny shrubs or trees; pods indehiscent ... **Prosopis**
        Spineless trees; pods dehiscent seeds red ... **Adenanthera**
      Seeds exalbuminous; great climbers, usually tendril-bearing, with very large pods and seeds ... **Entada**
Calyx lobes imbricate, very large trees with capitate inflorescence ... **Parkia**

ENTEROLOBIUM Mart.

Flowers 5-merous; calyx campanulate, shortly dentate; corolla funnel-shaped, segments united to the middle; stamens numerous, exserted; ovary sessile, many-ovuled; pod broad, reniform-curved or almost straight, fleshy, indehiscent.—Trees with bipinnate leaves; flowerheads fasciculate or shortly racemose.

About five species natives of tropical America. Only one, *E. cyclocarpum* Grieseb., cultivated in Hawaii.

Enterolobium cyclocarpum Grieseb. Fl. Brit. West Ind. Isl. 226. 1864.

Elephant's Ear.

Plate 1.

A lofty, quickly-growing tree, branching 15-20 feet above the ground, branches widely spreading; glabrous or young twigs pubescent; stipules obscure or not visible; common petiole about 6 cm, bearing glands between the lowest and uppermost pinnae; pinnae 4-9 pairs, each with 20-30 pairs of leaflets; leaflets unequal-sided, subsessile, truncate at the base, acute at the apex, the midrib near the upper margin, with two lateral nerves at the base, glaucous underneath, darker green above, the lateral petioles (of pinnae) articulate near the base, thickened and grayish pubescent; flowers white in globose heads on peduncles of 4-5 cm; calyx puberulous, more than half as long as the corolla; stamens numerous, united into a tube at the base; legume repand, forming a complete circle, the rounded top touching the rounded base, 12 cm long, about 6.5 cm wide, dark brown, polished, indehiscent, fleshy; seeds up to 16 or more.

Probably on all the larger islands, cultivated as a shade tree.

It is a native of Jamaica and the West Indian Islands, also Venezuela and Central America. It was introduced by Dr. William Hillebrand. The largest tree of this species occurs on the premises of Mrs. Mary E. Foster, formerly of the late Dr. W. Hillebrand. During the winter season the tree is deciduous for a short time.

Owing to its rapid growth and spreading branches it can be recommended for planting as a shade tree. As the tree reaches an enormous size, it should be planted only on large areas; it should not be planted near to dwellings, as the roots, which are of enormous size, are more or less surface roots and are likely to lift and tilt houses, as can be seen in Mrs. M. E. Foster's grounds, where the two-story residence has been raised considerably on the side nearest the immense tree previously mentioned.

The branches of the young trees, or young branches and twigs of older trees, are good for lopping (green manuring). The bark of this species is employed in washing. It contains also tannin. The wood is used for building and construction purposes.

The tree went under the name of *Parkia africana* in Honolulu until recently.

Herbarium specimen: In College of Hawaii Herbarium no. 12863.

PLATE 1.

ENTEROLOBIUM CYCLOCARPUM Griseb.
Elephant's Ear.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

PITHECOLOBIUM Mart.

Flowers 5-merous, hermaphrodite; calyx campanulate or tubular, shortly dentate; corolla tubular or funnel-shaped, segments united to above the middle; stamens numerous, often united nearly to the apex; ovary sessile or stipitate, many-ovuled; pod flat compressed snail-like twisted, coriaceous, 2-valved, the valves twisted after dehiscence; seeds flat, ovate or orbicular, the funis usually transformed into a fleshy arillus. Usually unarmed or shrubs or trees with thorn-like stipules; leaves bipinnate; the white or pinkish flowers arranged in heads or racemes, either axillary or terminal.

A genus of about 110 species, mostly natives of tropical America and Asia; only few occur in tropical Africa and Australia. Only two species are in cultivation in Hawaii, *Pithecolobium dulce* and *P. unguis-cati.*

KEY TO THE SPECIES.

Flowers white in long panicled racemes, funiculus fleshy white	**P. dulce**
Flowers half purplish half white, the enlarged fleshy funicle red	**P. unguis-cati**

Pithecolobium unguis-cati Benth. in Hook. Lond. Journ. Bot. 3:200. 1844.

A shrub 3 m or more high, armed with minute, spinescent stipules, glabrous, pinnae 1-jugal, leaflets 1-jugal, obliquely obovate or oblong, blunt; flowers sessile in peduncled, racemose heads; legume circinate, flat compressed, broadly linear, glabrous, forming somewhat more than a single gyrus. The flowers of this species are half purplish and half white; the enlarged funicle is red instead of whitish as in the other species.

It is a native of the West Indies, Bahamas, Trinidad, etc., but is not as widely cultivated, if at all, like *Pithecolobium dulce.*

Pithecolobium unguis-cati is a late introduction. It was probably introduced by Mr. G. P. Wilder, or came in shipments of seeds from South America or the West Indies. The plants were grown at the Board of Agriculture and Forestry, and young plants were set out at the College grounds in front of the Engineering Laboratory, where they have flowered and fruited, for the first time in January, 1918.

Griesebach, in his Flora of the West Indian Islands, reports two varieties of this species, a variety α with yellow and purpurascent stamens and a variety β *forfex* with rosy stamens.

Our plant has whitish stamens which are purpurascent towards the base, but quite conspicuously so. It may belong to variety α of Griesebach, but is apparently only a form of the species.

It is a strong and rapid grower. As it does not develop a main trunk, but branches from the base, it makes an excellent hedge plant.

Pithecolobium dulce (Roxb.) Benth. in Hook. Lond. Journ. Bot. 3:199. 1844.

Opiuma.

Plate 2.

A middle-sized, glabrous, evergreen tree, armed with straight, stipulary thorns; leaves (bipinnate) pinnae 2, each with one pair of pale green, coriaceous, unequal-sided usually obtuse leaflets, 2.5-5 cm long, common and partial

PLATE 2.

PITHECOLOBIUM DULCE (Roxb.) Benth.
Opiuma.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

rhachis slender terminating in short bristles; flowers white in small globose sessile or short peduncled heads, arranged in long panicled racemes: pods linear, turgid, twisted 10-12.5 cm long; the black seeds are embedded in a whitish pulp which is the enlarged funicle.

This tree is known in our Islands as *Opiuma,* but elsewhere as "Manila Tamarind."

It is a native of tropical America, as Central America and Mexico, but has been in cultivation in many tropical countries. It has become naturalized in the Hawaiian Islands and may be found growing of its own accord in many waste places, the seeds being distributed by birds. The seeds of this tree yield a fatty oil as thick as that of the castor bean. The sapwood is small, the heartwood reddish brown, which smells very unpleasantly when freshly cut. It is used for crates and packing boxes and also for fuel. It makes a good avenue tree and is also suitable as a hedge plant. The bark contains 25% of tannin and is one of the principal sources of that material in Mexico.

SAMANEA (Benth.) Merrill

Flowers pentamerous, hermaphrodite. Calyx shortly lobed. Petals valvate connate to the middle. Stamens many, united into a tube at the base, long exserted; anthers small, eglandulose. Ovary sessile, many-ovuled, style filiform, stigma minute, capitate. Pod straight or slightly curved, indehiscent, fleshy-compressed, epicarp thin crustaceous, mesocarp pulpy, endocarp rigidly crustaceous, continuous and forming septa between the seeds; the sutures thickened. Seeds numerous, transverse, oblong-ovate, slightly compressed, shining, exarillate, funicle filiform.

A large unarmed spreading tree. Leaves abruptly bipinnate, 4 to 6-jugate. Stipules lanceolate, small, deciduous. Peduncles solitary or subfasciculate. Flowers pink, pedicellate, arranged in globose heads, axillary or subterminal.

A single species, *S. saman,* a native of the northern part of South America.

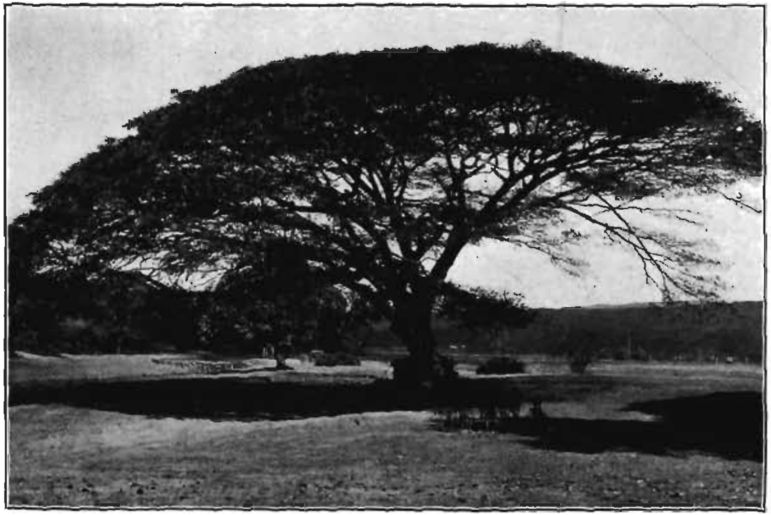
Samanea Saman (Jacq.) Merrill in Journ. Wash. Acad. Sci. 6, n. 2, 47. 1916.
Mimosa Saman Jacq. Fragm. 15, Pl. 9. 1800.
Inga Saman Willd. Spec. Pl. 4:1024. 1806.
Pithecolobium Saman Benth. in Hook. Lond. Journ. Bot. 3:101. 1844.
Calliandra Saman Grieseb. Fl. Brit. W. Ind. 225. 1864.
Albizzia Saman F. Muell. Select Extra-Trop. Pl. 27. 1891.
Enterolobium Saman Prain ex King in Journ. As. Soc. Beng. 66²:352. 1897.

Monkey Pod or *Rain Tree.*

Plate 3.

A large tree reaching a height of 20 to 25 m, the branches wide-spreading; leaves evenly 2-pinnate, pinnae 8 to 12, 15 cm long or less; leaflets 12 to 16 in the upper pinnae, 6 to 10 in the lower ones, decreasing in size downward, pubescent beneath, oblong-rhomboid, base and apex more or less oblique, the midnerve diagonal, 1.5 to 4 cm long; flowers pink in dense peduncled, axillary solitary or fascicled heads; pod straight, somewhat fleshy, indehiscent, 15 to 20 cm long, 2 cm wide, the mesocarp pulpy, sweet.

PLATE 3.



SAMANEA SAMAN (Jacq.) Merrill
Monkey-pod or Rain Tree.

[From J. F. Rock; "The Ornamental Trees of Hawaii" (Copyrighted).]

The monkey-pod, as this species is called in Hawaii, is a native of the northern part of South America, but is now one of the most widely cultivated species of trees. It is remarkable for its quick growth, the ease with which it can be transplanted, and the rapidity with which it recovers from the most severe pruning when transplanted. It forms, on account of its widely spreading branches, one of the best shade trees. On account of the ease with which it can be propagated, and its very rapid growth, it gives promise of being of great value in reafforestation work. It is of early introduction in Hawaii, and magnificent trees may be found throughout Honolulu, as well as on the other islands.

ALBIZZIA Durass

Flowers usually 5-merous, hermaphrodite. Calyx campanulate or tubular, dentate or shortly lobed; corolla funnel-shaped, segments united to above the middle. Stamens many, united at the base or nearly to the apex into a tube, usually long exserted. Pod broadly-linear, straight, compressed, thin, dehiscing into 2 not twisted and inelastic valves or indehiscent, without pulp and not septate. Unarmed trees or shrubs with bipinnate leaves and numerous small, or few large leaflets. Flowers white, pink, yellow or rarely purplish in globose heads or cylindrical racemes, in either axillary or terminal panicles.

More than 50 species natives of tropical and subtropical Asia, Africa, and Australia, only introduced into America.

There are several species in cultivation in Hawaii which are represented by more or less numerous individuals.

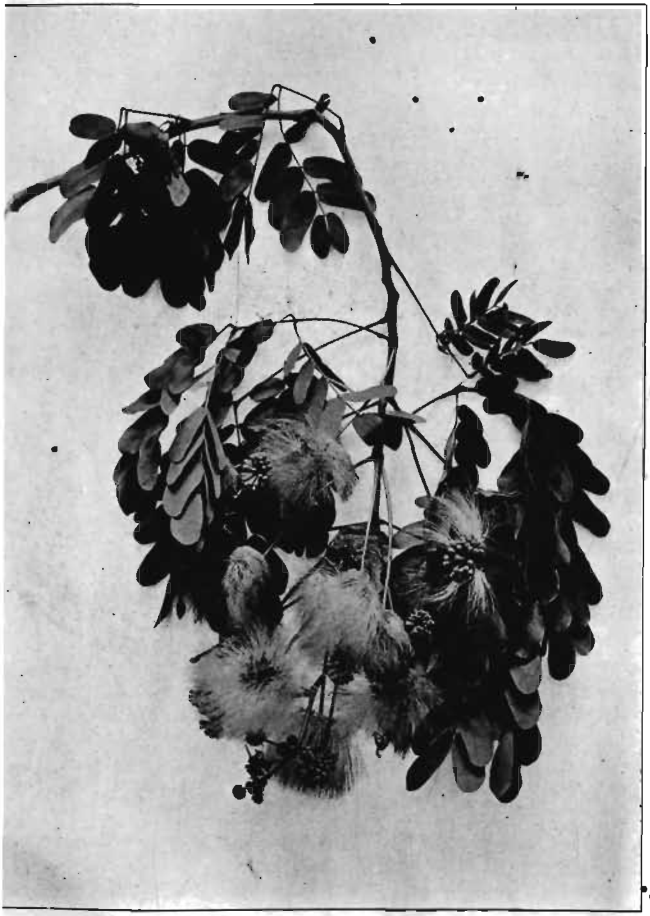
KEY TO THE SPECIES.

Leaflets small or medium sized, mostly oblong, ovate or linear-oblong.
- Leaflets oblong or ovate to obovate-oblong, obtuse or retuse.
  - Flowers sessile.
    - The portion of the leaflets on the upper side of the costa broader than the lower; pods 2 to 2.4 cm wide .... **Albizzia procera**
    - The portion of the leaflet on the upper side of the costa narrower than the lower; pods 3 to 5 (6) cm wide, seeds central ...... **Albizzia canescens**
  - Flowers pedicellate.
    - Leaflets subequilateral; umbels few-flowered; flowers including the stamens 1.5 cm long; stamens purplish .... **Albizzia retusa**
    - Leaflets inequilateral, the lower half broader than the upper; umbels many-flowered, flowers including the stamens about 3 cm long, greenish-white. .... **Albizzia Lebbek**
- Leaflets small linear, or linear oblong, usually more or less falcate.
  - Inflorescence paniculate or corymbose.
    - Pinnae 4 to 8-jugate, costa distinct from the upper margin of the leaflets .. .. **Albizzia lebbekoides**
    - Pinnae usually 9 to 15 (6 to 20), costa close to the upper margin of the leaflets, stipules large, inequilateral, caducous .... **Albizzia marginata**
  - Inflorescence spicate or rarely 1-3 branched.
    - Flowers white, pinnae 11 to 12-jugate, costa straight .... **Albizzia falcata**
    - Flowers deep yellow in dense spikes .... **Albizzia montana**

Leaflets large ovate or acuminate, the upper one 10 to 18 cm long.
- Pinnae 2-jugate, leaflets pubescent, inflorescence terminal flowers white .... **Albizzia saponaria**
- Pinnae 1-jugate, leaflets entirely glabrous, inflorescence axillary .... **Albizzia acle**

ALBIZZIA PROCERA (Roxb.) Benth.

PLATE 5.



ALBIZZIA LEBBEK (Linn.) Benth.
Siris Tree.

Albizzia procera (Roxb.) Benth. in Lond. Journ. Bot. 3:89. 1844.
Mimosa procera Roxb. Pl. Coromandel 2:12, t. 121. 1798.
Acacia procera Willd. Spec. Pl. 4:1063. 1805.

Plate 4.

An erect, slightly pubescent or nearly glabrous tree, 10-25 m or more in height; leaves about 40 cm long; pinnae 6 to 10, 15 to 20 cm long; leaflets 12 to 20, oblong-elliptical, rounded or retuse 2–4.5 cm long, somewhat oblique at the base, upper half of the leaflets broader than the lower, subcoriaceous, glabrous; leaf rhachis glabrescent with a large gland near the base of the petiole; panicles terminal or in the upper axils, up to 20 cm long, diffuse; flowers yellowish-white, in globose heads at the ends of the branchlets, the heads in flower 1 to 1.5 cm in diameter; pods oblong thin, smooth, flattened reddish-brown, 10 to 15 cm long, 2–2.4 cm wide, containing 8 to 10 seeds.

A native of India, Malay Isles, and Philippines.

This species was introduced into these islands by Dr. W. Hillebrand, in whose former premises several trees are still in existence. It is best suited for open grassy dry lands. It is a large deciduous, fast-growing tree, which yields large quantities of gum. The bark is sometimes employed as a tan. The sapwood is large, yellowish-white, and not durable, while the heartwood is hard, brown, shining, with alternate belts of darker and lighter color; the wood is straight, even-grained, seasons well, and the heartwood is durable, and as it yields excellent timber it is in great demand in India, where it is used in the manufacture of wheels, agricultural implements, bridges, and house posts. It splits well, and is occasionally used for tea boxes. It is also very good for charcoal.

In Dr. Hillebrand's garden there is one very tall tree about 80 feet in height, with a straight, beautiful trunk nearly two feet in diameter. The tree should be planted in ranch lands as well as in the lowlands near plantations where wood is in demand for fence posts, etc.

Seedlings should immediately be grown for distribution before the old trees in Hillebrand's garden become a thing of the past.

Albizzia Lebbek (Linn.) Benth. in Hook. Lond. Journ. Bot. 3:87. 1844.
Mimosa Lebbek Linn. Spec. Plant. 516. 1753.

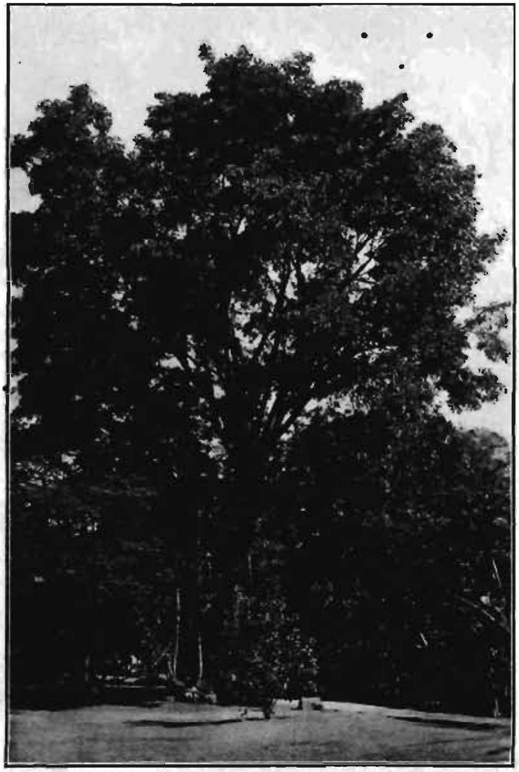
Siris Tree.

Plates 5 and 6.

A large deciduous tree, with dark gray or brownish bark, sapwood large, white, heartwood dark brown, shining, mottled; nearly glabrous; pinnae 2–3, leaflets 6–8 pairs, obliquely oblong obtuse, 2.5–3.5 cm long; midrib prominent; flowerheads large, white or greenish, fragrant on peduncles of 5–10 cm, in fascicles of 2–4 from the upper axils, forming short corymbose racemes; pod thin, straw-colored dehiscent, 20–30 cm long, 2.5–5 cm wide.

The Siris tree is a native of both Indias, but is especially common in the subhimalayan tracts where it ascends to an elevation of 5000 feet. It is planted extensively throughout the tropics, and is not uncommon in Honolulu, or elsewhere in the Hawaiian Islands.

PLATE 6.



ALBIZZIA LEBBEK (Linn.) Benth.
Siris Tree growing in Moanalua Garden.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

In India the leaves are used as fodder for camels, and is generally culti-
vated as a fodder plant. The tree grows rapidly and flourishes on almost any soil. It should be planted in localities where both fodder and fuel are scarce. It may well rival with the algaroba in these islands, as far as firewood is concerned, and certainly deserves to be cultivated to a much greater extent. As it can stand frost and snow, it would be well to plant it on our uplands in the drier localities. As a whole it may well be recommended. The value of the tree may be inferred from the fact that the Burmese Government fixed a higher tax upon the felling of this species than for teak or any other tree.

The wood may be employed for many purposes,—as furniture, wheel-work, boats, building purposes, posts, etc.

Albizzia retusa Benth. in Hook. Lond. Journ. Bot. 3:90. 1844.
Albizzia littoralis Teysm. & Binn. Nat. Tijdschr. Ned. Ind. 29:259. 1867.

A small or medium-sized tree, branches and petioles lenticellate, pinna 3 to 4-jugate, leaflets obovate-oblong, obtuse and retuse, the base oblique, puberulous beneath, finally glabrate, 20 to 35 mm long, 15 to 24 mm wide; gland near the base of the petiole; inflorescence an axillary or terminal panicle about 15 cm long, few-flowered, flowers pedicellate, pedicels about 3 mm long; calyx a third the length of the corolla, denticulate or subtruncate, stamens long exserted, purplish-red; ovary shortly stipitate, linear, glabrous; pod similar to that of *Albizzia procera*, but broader, 14 to 16-seeded.

Albizzia retusa is of wide distribution; it occurs in Java, Philippines, Amboina, Celebes, the Caroline Islands, Nicobar Island, and Penang, where it seems to be confined to the beach forest.

Only one single mature individual occurs in Hawaii. It was introduced by Dr. W. Hillebrand and can still be found in his former premises on Nuuanu Avenue, where it fruits profusely every year. It flowers end of April or beginning of May.

It comes close to *Albizzia procera*, but differs from it in the smaller stature, broader pods, and purplish pedicellate (stalked) flowers.

Albizzia canescens Benth. Flora Austr. 2:423. 1864.

A beautiful spreading tree, the young shoots silky pubescent, the adult foliage more or less hoary with a very minute appressed pubescence; pinnae usually 2 pairs, rarely a third pair, the common petiole 5 to 10 cm long, each rhachis 7.5 to 15 cm long; leaflets 5 to 8 pairs on the terminal pinnae, very obliquely obovate and unequally narrowed at the base, mostly 3 to 4 cm long, fewer and smaller on the lower pinnae, penniveined, but the veins much less prominent than in *A. lebbek*; flowerheads small, numerous, on short peduncles in dense terminal panicles much shorter than the last leaves; flowers sessile, mostly pentamerous; calyx 2 mm, corolla about 5 mm long, both silky pubescent; stamens about 12 mm long, the united part shorter than the corolla; pod stipitate, often 20 to 25 cm long, 3.75 to 6 cm wide, very thin flat; seeds flat, orbicular, along the center of the pod.

PLATE 7.

ALBIZZIA MARGINATA (Lam.) Merrill

A native of Queensland, Australia. It is allied to *A. procera* on the one hand and on the other to *A. Lebbek*. The latter it resembles greatly, but the flowers are much smaller and are closely sessile.

There is only one single tree of this species in Hawaii. It is a large handsome tree and can be found in the Queen's Hospital grounds, near the entrance on the left hand side.

The pods of the Hawaiian-grown plant are not as large as given by Bentham.

Albizzia lebbekoides (DC.) Benth. in Hook. Lond. Journ. Bot. 3:89. 1844.

A tree attaining a height of 20 m or more; trunk 60 cm in diameter; stipules deciduous; common petiole 4 to 12 cm long, puberulous; gland small, situated 2 or 3 cm from the base; the others at the level of the secondary petioles; pinnae 2 to 4 pairs, 12 cm long; leaflets 18 to 22 pairs pale on both surfaces, 20 to 25 mm long, 5 to 7 mm wide; inflorescence axillary a pyramidal panicle or corymb, 10 cm long, branches attaining 6 cm in length; peduncle 10 to 20 mm; heads small, hemispherical; flowers sessile; calyx about 1 mm or more, with 5 rounded teeth; corolla about 4 mm, pubescent; stamens 20 or more, the tube 4.5 cm long; ovary glabrous; pod 13 cm long, 18 to 20 mm wide, attenuated at the base, shortly mucronate at the apex; seeds 10, elliptical.

A native of Java, the Philippines, Siam, and Cochin-China.

The writer knows of only one tree of this species in Hawaii. It was introduced in the early fifties by Dr. W. Hillebrand, in whose former premises the tree is still in existence. It is a large tree, with stout trunk. As a forest tree it may be well worth considering this species, and should by all means be propagated before the tree is either cut down or dies a natural death.

Albizzia marginata (Lam.) Merrill in Philippine Journ. Science 5:23. 1910.
Mimosa marginata Lam. Encycl. 1:12. 1783.
Albizzia stipulata Boiv. Encycl. 19 Siecle. 2:33. Benth. in Hook. Lond. Journ. Bot. 3:92. 1844.

Plate 7.

A tall unarmed tree, with finely gray downy branchlets; leaves with many glands on the rhachis; pinnae 12 to 40; leaflets 2 mm or less broad, 40 to 80 in number; membranous, sensitive, 6 to 8 mm long, sessile, glaucous beneath, finely downy, cordate, acute; stipules and bracts persistent; heads in copious axillary, simple and compound terminal racemes with densely erecto-patent branches; flowers white, corolla twice the calyx; pod 12.5 to 15 cm long, up to 2.5 cm wide, pale brown, thin, indehiscent, subsessile, 8 to 10-seeded.

A native of India, Ceylon, and the Malay Islands. In India it is not uncommon in the tropical Himalayas where it ascends to 4000 feet elevation.

It is a fairly quick-growing tree, and now quite commonly planted along roadsides in the lower hills back of Honolulu. A few specimens may be seen about town. Probably of early introduction.

Albizzia marginata furnishes a gum; it is obtained by making incisions into the bark of the trunk; it is employed in the manufacture of paper in Northern India, especially in Nepal.

PLATE 8.

ALBIZZIA SAPONARIA (Lour.) Blume

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

According to some authors the young leaves of this species are said to be *injurious to livestock*, while others claim that the old leaves are suitable for fodder and are used as such in India.

Albizzia falcata (Linn.) Baker in Merrill an Interpret. Rumph. Herb. Amb. 249. 1917.

Adenanthera falcata Linn. In Stickm. Herb. Amb. 14. 1754 (type).
Adenanthus falcataria Linn. Spec. Pl. ed. 2. 550. 1762 (type).
Albizzia moluccana Miq. Fl. Ind. Bat. 1[1]:26. 1855.

A tree 45 m high; young branches terete or subangulate; adult leaves long petiolate, destitute of stipules, pinnae 11 to 12-jugate, upper jugae always opposite, the lower somewhat alternate, leaflets 18 to 20 pairs, small, sessile, all opposite, rhomboid-oblong, obtuse or subacute at the base, acute at the apex; costa straight, leaflets 3-nerved at the base; petiolar gland at the middle or near the base of the petiole; young leaves with subulate stipules; flowers sessile, spicate; spikes axillary simple or branched; 1-3 forming a panicle-like inflorescence; calyx campanulate; corolla whitish, divided to near the base in 5 segments; pod narrow linear, dehiscent, many-seeded, 10 to 13 cm long 2 to 1.4 cm wide; seeds 7 mm long, 3 mm broad.

This species, commonly known as *Albizzia moluccana*, was introduced by the writer from British Borneo and Java in 1917. Hundreds of seedlings were grown and planted out by the Board of Agriculture and Forestry. Specimens have been set out on the College of Hawaii grounds, where they are doing splendidly. This species, a native of the Moluccas, reaches a height of over 120 feet during a period of less than 25 years, about its life period. Experiments carried on at the Gardens in Java showed that trees 2 years and 9 months old had reached a height of 56 feet, while trees nine years old had reached a height of over a hundred feet, a rapidity of growth almost unbelievable. In Hawaii the trees have not shown such phenomenal rate of growth, though their growth has been very rapid in comparison with other trees. The trees have reached an average height of 15 to 18 feet in about a year's growth. The species likes heavy clay soil, and an abundant amount of moisture. It can be advocated for plantings in heavy soil as a soil improver. The enormous root system which the tree develops produces channels for the draining and airing of the soil. The great amount of green manure produced by the fallen leaves tends to further improve the soil. The only objection to the tree is its short-lived period, but as it is an abundant seeder there should always be a good stand of this tree present.

A large quantity of seed of this species was again brought back by the writer from Java, where the tree is extensively cultivated.

Albizzia montana Benth. in Miqu. Pl. Junghun. 267. 1851-1855.

A tree up to 15 m high with a trunk 3.5 dm in diameter, usually only 5 m high and 10 cm trunk diameter; habitus peculiar on account of the Acacia-like foliage, and the handsome deep yellow flowers arranged in spikes.

The species is restricted to the higher levels on Mt. Gedeh, Western Java, elevation 6000-9000 feet, whence the writer collected large quantities of seed of this species.

The tree is well adapted for the higher levels on Mt. Haleakala, Mauna Loa, and Mauna Kea. It is very handsome on account of its beautiful crown of dark green feathery foliage and deep yellow flowers. The pods remind of those of *Leucaena glauca.*

Albizzia saponaria (Lour.) Blume ex Miq. Flora Ind. Bat. 1[1]:19. 1855.
Mimosa saponaria Lour. Fl. Cochinch. 653. 1790.

Plate 8.

A small to medium sized tree 5 to 10 m high; leaves 30 to 40 cm long; pinnae 4, the upper pair usually longer than the lower; leaflets 4 to 8, gradually larger towards the end of the pinnae, 5 to 15 cm long, ovate to elliptical ovate, acuminate, often inequilateral, more or less pubescent; panicles terminal pubescent, spreading, 15 to 30 cm long; flowers white, crowded in heads at the ends of the ultimate branchlets, heads in flower 1.5 to 2 cm in diameter; calyx pubescent; pods thin, flat, 7 to 18 cm long, 2.5 to 3 cm wide, containing 7 to 12 seeds.

A native of Malay and the Philippines, growing in open forest land. Only few specimens occur in Honolulu. The species was introduced by Dr. W. Hillebrand, in whose former premises specimens can still be found. Other specimens are in the Queen's Hospital gronnds, and back of the Episcopal Cathedral. The sapwood of this species is of a creamy white, the heartwood dark brown to almost black. It is moderately hard and heavy, and is used for general house construction in the Philippine Islands, also for furniture and fine interior finishings in the southern islands of that group.

From the writer's experience regarding the growing of this species it is evident that, like *Albizzia acle, A. saponaria* is of very slow growth.

Albizzia acle (Blanco) Merrill in Philip. Journ. Science 5:25. 1910.

This species is yet not established in the Islands; it has been imported recently and plants grown from seeds have been planted at the College of Hawaii grounds. It is a tree, reaching a height of 75-100 feet, and is a native of the Philippine Islands, where it occurs in Luzon. It is a valuable timber tree, and is widely distributed at low altitudes. The native name is *Acle.* Its bark, like that of *Albizzia saponaria,* contains a great deal of saponin, and is used instead of soap by the natives.

WALLACEODENDRON Koorders

Flowers regular pentamerous; calyx narrow campanulate, minutely and irregularly five dentate or denticulate. Petals valvate in the bud connate when young, later three or four or five free, adnate to the base of the staminal tube. Stamens numerous, exserted, connate into a tube at the base; anthers minute, versatile and without glands. Ovary free from the calyx, sessile, many-ovuled;

style filiform, stigma terminal, small. Pod oblong, straight or slightly falcate, flat-compressed, thick coriaceous, the continuous persistent sutures thickened; exocarp continuous or indistinctly articulate 2-valved; endocarp transversely articulate, articulations one-seeded. Seeds without pulp, oblong, compressed, with very long filiform funicle; testa hard, albumen none.

Wallaceodendron celebicum Koord. Meded. s'Lands Plantent. 19:446, 631. 1898.

A tree 35 to 40 m high, trunk erect, with buttresses at the base, bark gray, foetid, very bitter; leaves (adult) 2-jugate, (young) 6-7 jugate, 20 to 25 cm long, each juga 6 to 10-foliolate; leaflets very shortly petiolate, oblong or obovate or subrhomboidal-oblong, narrowing at the base acute at the apex or subobtuse 3 to 9 cm broad; pedicels 1 to 2 cm long; calyx 2.5 mm long; corolla tube 1 cm long, the lobes 0.75 cm long; stamens connate into a tube, about 2 cm long.

Wallaceodendron celebicum belongs to a monotypic genus, and is known in the Philippines under the native name of *Banuvo*. It is known at present only from Celebes and Philippines, where it grows near the seashore, but also occurring farther inland, and at considerable altitudes. The timber of this species is considered very valuable; it is moderately heavy and moderately hard.

At present there are only two young trees of this species in the islands. The writer imported two seedlings of this species from the Philippines in the fall of 1916. One was turned over to the Board of Agriculture, the other one was planted out in the College of Hawaii grounds, where it has made splendid growth, even resisting, and thriving well, during the severe drought of the summer of 1917. It would appear a valuable tree for the lowlands, and for planting near the sea.

The beautiful reddish-brown wood of this species is highly valued by the natives of Minahassa Celebes, where it is employed in the construction of bridges and houses. It is known as "Ironwood" on account of its durability.

CALLIANDRA Bentham

Flowers pentamerous, polygamous; calyx campanulate, dentate; corolla funnel-shaped or campanulate, segments united up to the middle; stamens many united at the base or to near the apex, long exserted, with glandular hairy, or rarely glabrous anthers. Pod linear, straight or somewhat curved, attenuate at the base, compressed with thickened sutures, 2-valved, valves elastically dehiscing from the apex to the base, not septate, without pulp. Shrubs or small unarmed trees. Stipules membranous or foliaceous, persistent, or sometimes transformed into thorns. Leaves bipinnate. Flowers in simple axillary heads or in terminal racemosely fasciculate heads, showy red or white often with very long stamens.

More than 100 species in tropical and subtropical America, only few occurring in India. There are possibly three species in cultivation in Honolulu, of ornamental value only.

PLATE 9.

CALLIANDRA HAEMATOMA Benth.

KEY TO SPECIES.

Leaves one-jugate, flowers red	**Calliandra haematoma**
Leaves two to four-jugate, flowers white	**Calliandra portoricensis**

Calliandra haematoma Benth. in Hook. Lond. Journ. Bot. 3:103. 1844.

Plate 9.

A much branching, woody shrub; leaves 1-jugate, common petiole 23-25 mm long, subligneous, rhachis of pinna 6 to 9 cm long, leaflets 8 pairs, increasing in size toward the apex, the lowest pair 9 mm long, the last pair at the apex of the rhachis 35 mm long, 1 cm broad, oblong, obtuse at the apex, mucronulate, inequilateral at the base, minutely petiolate; the median nerve dividing the leaflets into unequal halves, the narrower half the upper, the broader and lower with two distinct nerves of nearly the prominence of the median nerve; inflorescence capitate at the apex of the branchlets on peduncles of often 4 cm; calyx 1.5 mm, the broad lobes 1 mm; corolla blood-red, the tube 3 mm, the lobes 2.5 mm long, puberulous as is the calyx, both prominently nerved; stmens much exserted, about 2.5 cm long, united into a tube one-third their length; pod about 6 cm long or more, 7 to 8 mm broad, several-seeded.

A native of tropical America; cultivated in the days of Hillebrand, as he mentions it in his Flora of the Hawaiian Islands.

There are a very few specimens in cultivation, and all occur in Nuuanu Valley, one at the end of the car line, and one on the right hand side below Judd hill. It is of very slow growth, but worthy of cultivation on account of its large, red, showy flowerheads.

Specimens have been planted at the College of Hawaii grounds.

Calliandra portoricensis (Jacq.) Benth. in Hook. Lond. Journ. 3:99. 1844.
Mimosa Portoricensis Jacq. Icon. Rar. 3:20. tab. 633. 1786-1793.

Shrub with slender terete, somewhat virgate, glabrous branches; leaves glabrous, or rhachis puberulous; pinnae two to four-jugate; leaflets linear-oblong, very oblique at the base, broadly pointed, sessile, 6 to 12 mm long, in 8 or 10 to upwards of 30 pairs; stipules oblong lanceolate persistent; peduncles very slender, axillary or collected in lateral or terminal leafless racemes; flowers white; pod 5 to 7.5 cm long, 6 mm wide, much narrowed at the base, obtuse often mucronate at the apex; the valves abruptly and transversely depressed between the seeds when ripe; the sutural margins prominent continuous.

A very handsome white-flowering *Calliandra* introduced by the writer from southern California. It has been planted on the College grounds. It is a shrub or small tree, without spines, and is a native of the West Indies, and is also found in tropical America and tropical Africa. Worthy of cultivation on account of its handsome white flowers.

ACACIA Willdenow

Flowers hermaphrodite or polygamous. Calyx campanulate, dentate or lobed. Petals free or more or less united or united with the stamens. Stamens many, free or only at the base and irregularly united; ovary sessile or stipitate, 2 to

many-ovuled. Pod ovate, oblong or linear, straight, curved or twisted, flat, convex, or terete, membranous or coriaceous, 2-valved or indehiscent. Seeds transverse or vertical, usually ovoid compressed. Unarmed, spiny or thorny trees, rarely herbs. Leaves bipinnate or reduced to a dilated petiole (phyllodium). Glands more or less conspicuous. Stipules missing or small or transformed into straight or curved thorns. Flowers small, numerous, usually yellow, rarely white, in stipitate globose heads or cylindrical catkins either single or 2 or fasciculate in the axils of the leaves, or terminal and then racemosely paniculate.

About 450 species of the tropical and subtropical regions of both hemispheres, especially numerous in Australia and Africa.

Besides the three endemic species there are a few Australian species in cultivation; also one or two African species.

KEY TO THE SPECIES.

Leaves reduced to simple flat straight or falcate phyllodia (dilated petioles).
  Flowers in spikes.
    Pod linear, 10 cm long, 4 to 8 mm broad, phyllodes oblong-lanceolate .... **A. longifolia** (Australian)
    Pod spirally twisted, the outer margin sinuate, 12 to 16 mm broad, phyllodes falcate oblong, narrowed at both ends .... **A. auriculaeformis**
  Flowers in globose heads.
    Phyllodia strongly falcate (**Hawaiian**).
      Sepals and petals united, flower-heads in axillary racemes.
        Pod broad and straight .... **A. koa**
        Pod narrow and curved .... **A. koaia**
      Sepals and petals free, flower-heads in a terminal panicle .... **A. Kauaiensis**
    Phyllodia somewhat falcate or straight (foreign).
      Phyllodia 5-nerved, apex blunt, flower-heads axillary, solitary .... **A. confusa** (Philippine)
      Phyllodia nearly straight many-nerved, oblong, obtuse, inflorescence a short raceme or flower-head single .... **A. melanoxylon** (Australian)
      Phyllodia oblong lanceolate or linear, slightly falcate, one-nerved.
        Calyx truncate, minutely toothed, branches pendulous .... **A. salicina** (Australian)
        Sepals united, the broad lobes ciliate, branches erect .... **A. retinodes** (Australian)
Leaves all bipinnate. (True leaves.)
  Flowers in spikes.
    Spines horn-like large (myrmecophilous = ant-inhabited), spikes densely-flowered. .... **A. cornigera** (American)
    Spines stipular, short, spikes sub-densely flowered, flowers pale yellow, pod flat. .... **A. catechu** (India)
  Flowers in globose heads.
    Legume constricted between the seeds, gray pubescent, compressed .... **A. arabica** (Asiatic-African)
    Legume black thick, turgid or cylindrical .... **A. farnesiana** (American)
    Legume flat, more or less contracted between the seeds, pinnae glabrous (young shoots of a yellowish or golden tinge) .... **A. decurrens** (Australian)
      Silvery tomentose or very glaucous .... var. **dealbata**

Acacia confusa Merrill in Philipp. Journ. Scie. Vol. 5:27. 1910.

A glabrous tree 6 to 15 m tall; branches terete, gray or brown; phyllodes narrowly lanceolate subcoriaceous, rather distinctly falcate, 6 to 11 cm long, 5 to 8 mm wide, gradually narrowed at both ends, the apex rather blunt, sometimes subacute; nerves about 5, distinct; heads axillary solitary about 5 mm in diameter; peduncles slender, about 1 cm long; flowers yellow with a faint

odor, the calyx 2 mm long; pod 4 to 9 cm long, 7 to 10 mm wide, dark colored when dry, shining, base acute or acuminate; the apex acute or somewhat curved apiculate, inflated opposite the seeds and frequently constricted between them, scarcely reticulated; seeds 4 to 8, elliptical, compressed 5 mm long, their longer diameter arranged parallel with the pod, not at right angles to it.

Acacia confusa is a native of both Formosa and the Philippines; seeds have been imported both by the Board of Agriculture and Forestry and also by the H. S. P. A., in whose nurseries seedlings have been raised. Specimens have been planted at the College of Hawaii grounds.

The species was previously confused with *Acacia richii* Gray, a native of Fiji.

Acacia retinodes Schlecht. in Linn. 20:644. 1847.

A moderate-sized glabrous tree, branches at first angular; phyllodia linear-lanceolate, more or less falcate, with a small recurved point or obtuse, much narrowed towards the base, mostly 7.5 to 12.5 cm long, one-nerved, finely penniveined, the marginal gland above the base rarely wanting; racemes much shorter than the phyllodia, almost always branched, with several, often ten to twenty, small globular heads of twelve to twenty flowers; calyx thin, not half as long as the corolla, with very short broad ciliate lobes; petals smooth, united to the middle, but readily separating; pod shortly stipitate, usually straight, nearly flat, 7.5 to 20 cm long, 6 to 8 mm broad; seeds oblong, the funicle dilated and colored nearly from the base, extending round the seed and bent back on the same side, encircling it in a double fold.

A native of Australia, where it occurs in Victoria and South Australia. It loves the open valleys and grassy ridges, and is also frequent near water in rich soils.

It has been of late in cultivation in Hawaii, especially Honolulu, and again in Nuuanu Valley, with *Acacia salicina*, from which it differs in having the branches erect, while those of the latter species are pendulous; the phyllodia are linear-lanceolate and not oblong and acute.

The species is cultivated extensively in California, whence it was introduced into Hawaii.

Acacia salicina Lindl. in Mitch. Three Exped. 2:20. 1839.

A tall shrub or small tree, with pendulous branches, foliage pale or glaucous, glabrous; branchlets scarcely angular; phyllodia nearly straight, oblong-linear or lanceolate, obtuse or slightly acuminate, much narrowed at the base, 5 to 12.5 cm long, about 1.25 cm wide, rather thick, midrib scarcely prominent; racemes short, irregularly bearing two or three dense globular heads or reduced to a single head; flowers twenty or more; calyx short truncate, entire or minutely toothed; petals smooth; pod straight, 2.5 to 7.5 cm long, usually about 6 mm broad; valves somewhat convex, hard and thick; seed orbicular, funicle thickened, usually scarlet, almost free from the base, forming several folds under the seed.

Acacia salicina is a native Australia, where it occurs in Queensland, New South Wales, Victoria, South and West Australia. It has been in cultivation in

COIMBATORE

PLATE 10.

ACACIA KOA A. Gray
Koa.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

Hawaii only very recently; flowering, apparently mature shrubs can be seen on Nuuanu Avenue, between Judd and Wyllie Streets. Mrs. George Sherman has several plants of this species on her premises. In its native home it grows on banks of creeks and open forest land and also in the desert interior of South Australia. On account of its pendulous branches it is rather ornamental, and hence found its way into cultivation.

The writer is indebted to Dr. J. H. Maiden, Director of the Sydney Botanical Garden, for the identification of this species.

Acacia melanoxylon R. Br. in Ait Hort. Kew. ed. 2, 5:462. 1813.

Australian Blackwood.

A hard-wooded tree, attaining a very large size; phyllodia falcate oblong or almost lanceolate; 7.5-10 cm long, up to 2.5 cm wide, obtuse or rarely acute, coriaceous, with several longitudinal nerves; peduncles few together forming a short raceme or single, 6-8 mm long, bearing each a globose head of 30-50 flowers; calyx more than half as long as the corolla, shortly dentate; petals connate above the middle; pod elongate, flat, often curved, 6-8 mm broad, with thickened margins; seed sub-orbicular.

The Australian Blackwood, as *Acacia melanoxylon* is commonly called, has been more or less extensively planted on the higher elevations on the larger islands. It is not uncommon on Tantalus and elsewhere on Oahu. On Kauai it has been planted at elevations of 4000 feet at Halemanu and elsewhere.

It is a native of New South Wales, South Australia, and Tasmania. It resembles the Hawaiian *Acacia Koa*, but differs from it mainly in the straighter and shorter phyllodes and the narrow curved pod. In the latter respect it comes close to our *Acacia Koaia*. The habit of growth differs considerably from that of the *Koa*, in that the branches are ascending and form a pointed crown, while those of the Koa are spreading and form a broad round crown. The Blackwood reproduces itself also by offshoots from roots which reach the surface and are exposed. Several young trees may always be found within a short distance from an older tree.

Much has been written about this species. Suffice it to say that it is not a quick-growing tree, and that the wood is recommended as very valuable and high-class. The bark is rich in tannic acid, and contains also saponin. Propagation of this species is from seed; its rather slow growth is against it, and as an avenue tree it is a failure. *Acacia Koa* should always be preferred to *Acacia melanoxylon*: the former is a quicker grower and is also much handsomer. The wood is also more valuable than that of the Blackwood.

Acacia Koa Asa Gray, Bot. U. S. Expl. Exped. 480. 1854.
Acacia heterophylla Hook. et Arn. Voy. Bot. Beech. 81. 1832.

Koa.

Plate 10.

Phyllodia falcate, coriaceous, 10-15 cm long, varying from 6-8 mm to 24 mm or more in breadth, narrowed at the base, acute or obtuse at the tapering

PLATE 11.

ACACIA KOA HAWAIIENSIS Rock

Koa.

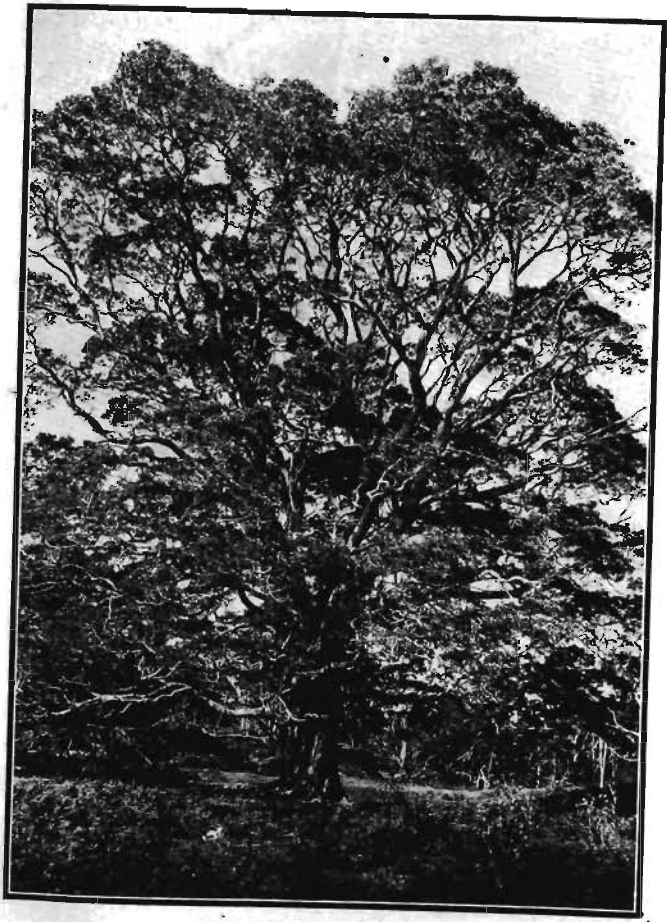
apex; the smooth surface is striate with many nerves, leaves on young plants bipinnate, each pinna consisting of 12-15 pairs of oblong emarginate, crowded leaflets; peduncles solitary or fascicled in the axils, about 12 mm long, bearing a dense many-flowered head 8 mm in diameter; calyx teeth very short; petals 5, oblong lanceolate, glabrous, more or less united, longer than the calyx, half the length of the stamens; legume broadly linear, straight or slightly falcate, 7.5-15 cm long, 16-18 mm broad, glabrous, flat, about 12-seeded, seeds flat, dark brown to black.

Acacia heterophylla Willd., with which *Acacia Koa* was first identified by Gaudichaud, who had seen both the Hawaiian plants and those of the island of Bourbon (Mauritius) growing in their respective native countries, differs from the Hawaiian *A. Koa* established by A. Gray very little, indeed, if at all. The writer has an authentic flowering specimen of *Acacia heterophylla* Willd. before him from the Royal Gardens, Pamplemousses, Mauritius; the flowers which the writer examined of the last mentioned species differ very little from those of *Acacia Koa;* the sepals and petals in the Hawaiian plant are dentiform, and like the petals united; the former are somewhat more deeply cut or in other words a little more lobed than in *A. heterophylla.* In the latter species the petals are slightly longer than in *Acacia Koa.* The *phyllodia* in *A. heterophylla* are much straighter, but are otherwise the same as in *A. Koa;* the leaflets are slightly shorter and broader. The difference, however, between *Acacia heterophylla* and *Acacia Koa* is much less pronounced than that between *Acacia Koa* and *Acacia Koaia.* Asa Gray was correct in his statement: "*In distinguishing the two trees, peculiar to these most widely separated stations, perhaps I incur the charge of being influenced by geographical considerations rather than botanical characters.*"

Unfortunately the specimen in the College of Hawaii Herbarium of *A. heterophylla* has no pods, but from the description in Baker's Flora of Mauritius it can be judged that they do not differ much from those of the Hawaiian trees. On Hawaii the trees of *Acacia Koa* have certainly a different aspect from those of Oahu, and broad *phyllode* specimens were named var. *latifolia* by Bentham; A. Gray states that it is only a state of the species. It is true that the *phyllodes* when young are of a different shape from the older ones, but in the Hawaii plants the mature *phyllodes* of any tree are much broader and ovate-oblong, and notwithstanding their width are shorter than or rarely as long as the Oahu specimens; they are, however, often more than twice as broad as those in the Oahu specimens. Whether the name *latifolia* was applied by Bentham to the young form of an Oahu specimen or to the typical Hawaii broad-leaved form cannot be determined now.

It is extremely interesting to find that in so widely separated regions as Mauritius, off the coast of Madagascar, in the southern hemisphere, and the Hawaiian Islands, in the middle of the North Pacific Ocean, there should occur two *Acacia* practically not at all differing from each other. In the writer's opinion, A. Gray was not justified in establishing the Hawaiian *Acacia* as a

PLATE 12.



ACACIA KOA HAWAIIENSIS Rock

Koa. Tree about 80 feet tall, growing near the Volcano of Kilauea, Hawaii.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

ATE 13.

ACACIA KOA HAWAIIENSIS Rock
es with straight boles, growing in wet fern forest near the Volcano of Kilauea, Hawaii.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

separate species for mere geographical reasons. It may be stated that it is not taken for granted that *Acacia Koa* is derived from *Acacia heterophylla* or vice versa, but that they are an offspring from a common ancestor, the home of which was or is undoubtedly Australia, and that owing to similarity in climate and environment both have developed on common lines, notwithstanding the vast distance separating these geographical stations. The common ancestor may also be looked for in relatives of *Acacia melanoxylon*, which has also connate sepals and petals, but varies mainly in the pod, which, however, comes exceedingly close to our *Acacia Koaia*.

Acacia Koa lanaiensis Rock in Bot. Bull.* No. 5:21, pl. 5. 1919.
Acacia Koa β var. Hillebr. Flora Haw. Isl. 113. 1888.

A medium-sized tree, branching habit of the species, phyllodes 3.5-8 cm long, 8-15 mm wide, very little curved, almost straight, obtuse, mucronate, petiole about 4 mm, with the usual gland on the upper side; racemes very short, flowerhead and flowers as in the species; pod not seen.

LANAI: Hillebrand in Herbarium Berlin and part of type in the Herbarium of the College of Hawaii;—Puu Manu, elevation 1000 feet, also Waiakeaku, the last valley of the main ridge, flowering July 29, 1910, Rock no. 8028 in Herbarium College of Hawaii.

Hillebrand's specimens of this variety are much more distinct than the writer's from Waiakeaku. While short obtuse *phyllodes* occur, long acuminate ones occur also. As a whole the plant from Waiakeaku is little distinct, but Hillebrand's specimens are undoubtedly worthy of varietal rank.

Acacia Koa hawaiiensis Rock in Bot. Bull. No. 5:23, pl. 6. 1919.

Plates 11, 12, and 13.

A lofty tree reaching 25-33 m, and a diameter 1.7-2 m; branches gnarled wide spreading; glabrate when old, densely tomentose when young, with a yellowish green velvety tomentum; leaflets broadly sessile with an oblique base, narrower towards the apex, rounded, with minute mucro, glabrate on both sides, but rhachis tomentose; phyllodia broad obovate to ovate to linear-oblong, hairy when young on both surfaces, but soon glabrate, slightly curved, acute at both ends or obtuse at the apex and uncinate, many nerved (usually ten), 12.5-16 cm long, 2.5-5 cm wide, coriaceous, on petioles of about 5 mm, with a gland on the upper side at the base of the phyllode; flowerheads single or two or three on a common peduncle of 1.5 mm, and the lateral ones, 3 mm; heads densely flowered small; sepals one-third the length of the calyx, hirsute at the apex; stamens numerous; petals ovate, obtuse more than one-third the length of the corolla, pod about 11 cm long, 2.5 cm wide, flat, the suture straight or slightly wavy.

HAWAII: At the higher levels from 4000 to 6000 feet elevation;—Mt. Hualalai-Hinakapauula, fruiting June 10, 1919, Rock no. 3759;—Pulehua plains and forests, South Kona, flowering January 1912, Rock no. 12866;—Kau desert,

*Board of Agriculture and Forestry Terr. Hawaii.

PLATE 14.

ACACIA KAUAIENSIS Hillebr.

PLATE 15.

ACACIA KOAIA Hillebr.
Koaie or Koaia.

elevation 3600 feet, July 15, 1915, Rock no. 12566– all in the College of Hawaii Herbarium.

This variety seems to be peculiar to the Island of Hawaii, where it reaches very large dimensions. It can be distinguished mainly by its broad *phyllodes*, which are almost straight.

Acacia Kauaiensis Hillebr. Flora Haw. Isl. 113. 1888.

Plate 14.

A large tree with many tortuous branches: phyllodia falciform, narrow-linear, 10-16 cm long, about 12 mm or less wide, with usually two or three prominent nerves, apex somewhat obtuse, mucronate-uncinate, with a pitted gland on the somewhat thickened petiole; inflorescence paniculate, terminal, foliose, or rather a paniculate raceme with phyllodia in the upper axils and below which are situated the peduncles of about 1 cm in length, each bearing several single-headed pedicels 4-6 mm in length, tomentose with a rusty tomentum; bracts minute; sepals 5-6, free to near the base, spathulate-obtuse, glandular pubescent as are the petals, the latter oblanceolate, one-half longer than the sepals, ovary puberulous; pod straight thick, coriaceous, 15 cm long, 2 cm wide, about 15-seeded, seeds as in *A. Koa.*

KAUAI: Halemanu, Knudsen no. 55;—Halemanu, fruiting February 14-26, 1909, Rock *no.* 2154 *in* College of Hawaii Herbarium;—Kaholuamano, outskirts of the forest, flowering October 1911, Rock no. 2755-b (typical); same locality, flowering October 1916, Rock no. 12868 in the Herbarium of the College of Hawaii.

The apparently typical form is no. 2755 from Kaholuamano and no. 2154 from Halemaumau, where V. Knudsen collected his specimens. The free sepals and petals, and the racemose-paniculate inflorescence, distinguish this species at once from the others; otherwise it has the same habit as *A. Koa*. This rather interesting tree, which Hillebrand established as a species, distinct from *A. Koa*, has hitherto been overlooked owing to its great resemblance to *Acacia Koa*. It inhabits the dry open slopes on the leeward side of Kauai on the edge of the canyons, especially on the Halemanu side along the Waimea canyon to Milolii. At the Kaholuamano side, where there seems to be a little more rainfall, the *phyllodia* are larger and the inflorescence is not exactly paniculate, though the sepals and petals are free. The tree does not reach such dimensions as the variety *hawaiiensis* of *Acacia Koa*, the trunk being usually short and the branches a good deal twisted and sometimes reclining on the ground. The *phyllodia* are long, sickle-shaped and narrow, the upper ones being uncinate. Similar to *Acacia Koa hawaiiensis*, when growing in damp or wet mixed forests in company with other trees, it develops a tall straight bole some forty feet without branches, after which the crown commences. Beyond the Kopiwai forest it grows in company with *Xanthoxylum dipetalum Hillebrandi* Rock (*X. dipetalum* var. γ Hillebr.), *Alphitonia excelsa*, *Antidesma platyphyllum*, *Pelea Kauaiensis*, *Santalum pyrularium*, and others.

Acacia Koaia *Hillebr. Flora Haw. Isl. 113. 1888.*

Koaie or Koaia.

Plate 15.

A small gnarled tree, wood hard, close grained; branches terete, true leaves not seen; phyllodia coriaceous, falcate, linear, narrow, acute at the apex, acuminate at the base, with three prominent nerves, 6-12 cm long, 8-10 mm broad, the apex with a recurved mucro; petiole about 5 mm, with a thickened gland on the convex side of the petiole or rather base of the phyllode; racemes axillary with not more than three heads, generally reduced to a single one; flowers as in *Acacia Koa;* pod very narrow, 8-10 mm in width, 10-15 cm long, somewhat curved, not of even width, but with slight constriction between the seeds; seeds oblong, the long diameter (6 mm) in the direction of the valves, flattened, with a funis of about the same length.

MOLOKAI: Kalae, Hillebrand in Herbarium Berlin and in the College of Hawaii Herbarium;—ridge above Kaunakakai and Kauluwai, March 1910, Rock in the College of Hawaii Herbarium.

MAUI: E. Maui, Kula? Hillebrand.

HAWAII: Puukawai, Kawaihaeiuka, elevation 2000 feet, near Waimea, flowering and fruiting June 1910, Rock no. 8346 in the College of Hawaii Herbarium;—observed back of Puuanahulu, near Puuwaawaa boundary, on rough ancient aa lava flows.

Acacia Koaia Hillebr. differs from *Acacia Koa* A. Gray mainly in the pods, which are very narrow and somewhat curved. Also in the *phyllodes*, which are narrow linear and less curved. *Acacia Koaia* or *Koaie*, as the natives call this species, and which name was adopted by Hillebrand as the specific name, has a rather restricted distribution. It seems to be the older of the two species occurring on these islands. So far as known, it is absent from Kauai, Oahu and Lanai, also Niihau and Kahoolawe. On the three remaining islands it occurs only sparingly. On Molokai the writer collected it at Mapulo-u immediately below Kamoku on the dry exposed ridges leading towards the dry stony slopes of the Kaunakakai-Kauluwai district. It is a small bushy tree on the crest and protected declivities of a ridge, where it grows in company with *Myoporum sandwicense, Nothocestrum latifolium, Sideroxylon molokaiense* Rock (*S. spathulatum molokaiense*) and a species of *Lipochaeta* (*Nehe*). On the same island it was collected by Hillebrand at Kalae. On Maui, it was collected by Hillebrand only, on the lee slopes of Haleakala at Kula. The Kula region is now almost barren and waste, save for a few *Dracaena aurea* (*Halapepe*) trees which were in existence a few years ago.

Until 1909 *Koaia* had not been recorded from the Island of Hawaii. The writer discovered it on the upper slopes of Kawaihae in the neighborhood of the extinct crater Puukawai along the road leading to Waimea. Quite a number of trees were then in existence. It was also quite common on the Puuanahulu side of Puuwaawaa, where it grew in company with tall *Osteomeles anthyllidifolia* (*Ulei*) bushes. As it occurs in the very arid rocky regions, it is doomed

to extinction, for such regions on Hawaii have been given over to cattle and sheep grazing; young plants which would perhaps germinate after southerly rains are eagerly devoured by both cattle and sheep. Owing to the causes just mentioned, *Koaia* has already disappeared from Maui. On Molokai a similar fate awaits it if it has not already been exterminated by roaming horses, cattle and sheep.

Acacia Koaia is easily distinguished from *koa* in the more rigid phyllodes and narrow, curved pods. It can be recognized even from a distance by its shape; its stature is much smaller than that of *Acacia Koa*, reaching rarely more than 25 feet. The trunk is usually gnarled and twisted. On Hawaii it associates with *Nothocestrum breviflorum*, *Sophora chrysophylla*, *Myoporum sandwicense*, *Nototrichium sandwicense* and *Dracaena aurea*. It is strictly a subxerophytic plant, inhabiting only the more arid lava regions or volcanic tufa soils such as predominate on Puukawai, Hawaii. It is never found on the newer lava flows as is, for example, the *Acacia Koa*, but in older geological regions. The Waimea side of Hawaii, known as the Kohala mountains, is extremely old and was evidently once a separate island from Hawaii. *Koaia* does not occur on the younger portion of Hawaii save near Puuanahulu, a place not distant and adjoining Kawaihaeiuka. It is probable that ages back it occurred only on the Kohala range and that it spread afterwards towards the plains and north Kona. Unfortunately, we know very little of the plant-covering which must have existed on the vast plains between Waimea and Mauna Kea. Evidences are still visible of former forests, but so meager are they that it is impossible to draw conclusions. Mamani (*Sophora chrysophylla*) forests must have extended considerably over this plain, as the upper part of that region would indicate by the scattered trees around Punohu and Makahalau. Kawaihaeiuka, judging from Hillebrand's reports, must have supported a similar vegetation, as does Puuwaawaa today, and *Acacia Koaia* may have been quite numerous there. Another factor influencing the (restricted) distribution of *Koaia* is undoubtedly the adaptability of the species to lower levels only, while *Koa* has been observed up to 7000 feet. *Koaia* does never ascend higher than 2500 feet, consequently the arid regions at such altitudes suitable to its existence are rather limited, while *Koa*, with its wonderful adaptability, which can be compared with that of *Metrosideros*, has a very wide distribution in these Islands and can be found from practically sea level to 7000 feet, in most varied stations, as to soils, and lava flows.

Acacia longifolia Willd. Spec. Pl. 4:1052. 1805.

An erect shrub, sometimes low and bushy, occasionally a small tree, glabrous or slightly pubescent when young; branchlets angular; phyllodia from broadly oblong to oblong-lanceolate, very obtuse or subacuminate, narrowed towards the base, with 2 to 5 more or less prominent longitudinal nerves and conspicuously axillary, loose and interrupted, flowers not imbricate; calyx very short, toothed; petals smooth, united at the base or sometimes quite separating; pod linear, about 10 cm long, 4 to 8 mm broad or rarely more; valves coriaceous, convex over the

PLATE 16.

ACACIA CATECHU Willd.

seeds, usually contracted between them: seeds often distant, funicle not much folded, thickened almost from the base into a turbinate almost cup-shaped aril at the base of the seed, and sometimes nearly as large.

A native of Australia; common in Queensland, New South Wales, Victoria, and Tasmania.

The species, which is rather attractive on account of the flowers being arranged in spikes instead of in heads, is cultivated in Hawaii only at Waimea, Hawaii, as far as the writer is aware. It is planted as a hedge, to which it lends itself on account of its low bushy nature, along the road to Kawaihae, but near or in the village of Waimea.

Acacia auriculaeformis A. Cunn. ex Benth. in Hook. Lond. Journ. Bot. 1:377. 1842.

A tree with long pendulous branches, glabrous and glaucous, the branches somewhat angular; phyllodia falcate-oblong, narrowed at both ends, 12.5 to 20 cm long, 2.5 to 4 cm wide, with usually three more or less prominent nerves, the finer nerves not crowded, but often anastomosing the principal nerves confluent with or near the margin at the base; pods very much twisted in an irregular spire when mature, hard almost woody, the outer edge sinuate as in some *Pithecolobiums*, the valves 12 to 16 mm broad, seeds black, about 12 in a pod, the funis orange yellow, much folded.

A native of North Australia and Queensland. There is a single tree of this species cultivated in Hawaii. It is an apparently mature tree, of handsome proportions, with long drooping branches; the broad phyllodes are of a light green on glaucous (=bluish) angular branches; the black seeds are small and surrounded by a much and irregularly folded funis. It grows in the Moanalua Japanese garden, Honolulu. As the tree is exceedingly ornamental, it is worthy of cultivation.

Acacia Catechu Willd. Spec. Plant. ed. quarta 4:1079. 1805.

Plate 16.

A medium or large sized tree, extremities pubescent at first; stipular spines short, usually from a stout base, acute, sometimes wanting; leaf rhachis 15 cm or more pubescent or glabrate or aculeolate, generally bearing several sessile glands between or near the pinnae, besides one towards the base; pinnae 10-30 (or 40) pairs; leaflets linear, more or less acute 2-5 mm long 1-1.5 mm broad, rather 30-50-jugate; spikes axillary, solitary or fascicled 5-12.5 cm long, pubescent or tomentose; flowers sub-dense sessile; calyx campanulate, acutely toothed, petals nearly twice as long as the calyx; legume broadly linear, straight or nearly so, flat, shortly stipitate 7.5-12.5 cm long up to 18 mm in width, valves coriaceous, glabrous, shining, 6-8 seeded.

OAHU: In and about Honolulu, Waikiki.
KAUAI: Dry side of the island, Waimea.
Probably also on the other islands.

PLATE 17.

ACACIA ARABICA Willd.

Acacia Catechu is a native of Africa, India, and Burma, and extends from there to Sikkim to an altitude of 5000 feet.

It is a moderate sized deciduous tree with a much cracked brown bark; the flowers are arranged in spikes instead of globose heads. It yields cutch or catechu, a pale yellow gum which is sweet to the taste and soluble in water. The gum is obtained by boiling down a decoction from chips of the heartwood. The name catechu originated from the Tamil Kati or Cate, the name of the plant, and *Chuana*, meaning to drop or distill. The resinous extract is also a powerful astringent.

The sapwood is yellowish white, the heartwood dark or light red, and extremely hard. It seasons well, is quite durable and is not attacked by white ants. Like *Acacia arabica*, it can be grown in the dry regions of our islands, and can be used as firewood, as it furnishes high heating powers due to the great amount of resin it contains. A ton of timber may be taken to yield 250-300 lbs. of cutch.

Acacia farnesiana (Linn.) Willd. Spec. Pl. 4:1083. 1805.
Mimosa farnesiana Linn. Spec. Pl. 521. 1753.

Klu.

A much branched spiny chrub 2 to 4 m high, the branches more or less zigzag, lenticellate, the spines stipular, sharp, 1 to 4 cm long, those on the branchlets smaller; leaves 5 to 8 cm long, pinnae usually 10 to 12; leaflets linear oblong, 15 to 40, 4 to 7 mm long; heads axillary, solitary or fascicled, globose, densely many-flowered, about 1 cm in diameter, the peduncles slender, pubescent, 2 to 3.5 cm long; flowers yellow, fragrant; pods turgid, 5 to 7 cm long, 1 to 1.5 cm wide, straight or curved.

A native of tropical America, but now found in many tropical countries. The species is widely spread throughout the Hawaiian Islands where it occurs in waste places, in valleys and the slopes of the leesides of all islands. It is almost equal in abundance to the *Algaroba, Prosopis juliflora.*

In the early days it was cultivated for the perfume of its flowers.

The roots and pods of this plant have an alliaceous odor, and in the Antilles are used for tanning, dyeing black, and in baths. The fragrant flowers, falsely known as *cassia* flowers, are much used in the making of perfumery. In Hawaii a company was once formed, which offered 80c gold per pound of the dry fragrant flowers. Any one acquainted with the hot dry regions where this plant grows, the spininess of the latter, and the exceedingly light weight of the flowers, can imagine that the enthusiasm of the flower pickers was not very great, and the whole thing was dropped entirely. It is now a curse in the dry districts, though to exterminate the plant is now an impossibility.

A gum exudes from the stem in considerable quantities, which is considered superior to gum arabic in the arts and in medicine.

The local name of the species is Klu, a corruption of glue, so named on account of its gum.

Acacia arabica Willd. Spec. Plant. edit. quarta 4:1085. 1805.

Plate 17.

A variable tree, extremities glabrous or shortly pubescent; stipular spines straight or nearly so, or almost absent as in Hawaiian grown specimens; pinnae usually from 3-12 pairs, rhachis glabrous, or pubescent, with or without a sessile gland between the lowest and occasionally one or two upper pairs; leaflets linear-oblong, obtuse glabrous, or thinly ciliolate 5 mm long, in 10-30 pairs; peduncles 2-6 from each axil, bibracteolate above the middle; flowers capitate, yellow; legume straight of slightly curved, compressed, moniliform, with deep constrictions, grey pubescent, 10-15 cm long.

OAHU: Nuuanu Valley grounds of Mrs. M. E. Foster, and on Mrs. Jaeger's premises on Punahou Street.

Acacia arabica is a native of Africa, and extends through Arabia to India and Afghanistan. It is known as the Indian *Gum Arabic Tree*. The specimen in cultivation in the first mentioned locality is a tree 40 feet in height, with a stout trunk vested in dark brown rough bark; it fruits profusely. The useful qualities of this tree are as follows:

The bark, which contains tannin is employed in the preparation of leather; the pod is also very valuable, as it contains a large percentage of tannin, and imparts a good and uniform color to leather.

Formerly an extract was prepared from the immature pods by expression which was known as *Acaciae verae succus* by the ancients. At the present day a drug known as *Akaka* or *Akakia* is imported to Bombay from Persia, and is kept by Mohammedan druggists in India.

The timber is highly prized because of its hardness and durability, and is also one of the principal trees for the rearing of lac insects.

Acacia arabica could well be planted in our arid regions, as it prefers a dry soil. It is never leafless. It can be grown as a forest crop in dry regions on the islands. It is excellent fuel wood, and could well compete with *Kiawe*. It yields a valuable timber while luxuriating on the poorest waste lands. It is thus one of the subjects for planting in poor soils or exposed situations, and continues to flourish during long periods of intense drought. It is one of the most useful trees for broadcast sowing, as the seed germinates readily and is hardy and independent of rain. It can be planted as a thick belt along roads to form a roadside avenue which would produce a vast amount of fodder when rain fails. The seeds embedded in a nutritious pod would be spread by cattle quite as easily as the algaroba or kiawe. It is of rapid growth, and would flourish on our dry arid lands, as it requires no water, and is one of the best agents to improve sterile tracts of land. It can only be recommended to the plantations to be planted as a fuel crop even in localities where algaroba will not succeed. The bark may be made use of or sold to tanneries. A full-sized

tree 8-10 years old will yield half a ton of bark. The tree will live up to 100 years of age, or even more. There are only two trees in Honolulu, and probably in all the islands. It was introduced by Dr. William Hillebrand, in whose former gronnds a tree is still in existence. Though crowded considerably by other trees which keep from it the so necessary sunlight, it flowers and fruits profusely during summer months. The seeds could be gathered and seedlings grown as an experiment, or seeds could be imported from India in large quantities and sown broadcast in leeside valleys of the Waianae Mountains. It will prove a valuable asset, and probably of equal economical value as the Kiawe.

Acacia decurrens Willd. Spec. Plant. edit. quart. 4:1072. 1805.

Black Wattle.

A handsome tree more or less glabrous, branches moderately or prominently angled, sometimes almost winged; pinnae 8-15 pairs or more, leaflets very numerous 30-40 pairs, or even more, linear 3.5-10 mm long; flowerheads small, globular in axillary racemes, the upper one forming a terminal panicle; flowers 20-30 in a head; calyx short ciliate, petals with more or less prominent midribs; pods usually 7.5-10 cm long, 6 mm wide or more, more or less contracted between the seeds; the latter ovate.

OAHU: Mt. Tantalus and elsewhere in the Territory.

Acacia decurrens, or Black Wattle, is a native of Australia and Tasmania. The bark is rich in tannin. The cultivation of this species is very easy, it being effected by sowing either broadcast or in rows. The seeds keep their vitality for several years, but they should be soaked in warm water before sowing. Bare or barren unutilized places may well be planted with this rather useful tree. The timber is much valued chiefly as fuel.

Acacia decurrens dealbata (Link.) F. v. M. Maiden Forest Flora of N. S. W. 3[a]:56, pl. 88, H. to N. 1907.

Silver Wattle.

A handsome tree closely resembling *A. decurrens* var. *mollis*. The branches and foliage of this species are very glaucous or hoary with a minute pubescens assuming a silvery white tinge; pinnae usually 10-20 pairs, leaflets 30 to 40 pairs, linear, crowded 4-6 mm long; glands usually numerous; flowerheads small, in axillary racemes or paniculate at the ends of the branches; legume broader as in *A. decurrens* not contracted between the seeds and more glaucous.

OAHU: On Mt. Tantalus and elsewhere in the group.

Acacia decurrens dealbata is a native of N. S. Wales and Tasmania. It is the Silver Wattle of the colonists, and goes by that name also in the Hawaiian Islands. It prefers for its habitation humid riverbanks and attains a height

PLATE 18.

LEUCAENA GLAUCA Benth.
Koa haole.

of 150 feet in its native home, supplying a clear tough timber which is principally used for fuel owing to its great heating power. The bark of this variety is quite inferior to the Black Wattle in quality, as it yields only about half the quantity of tannin.

Acacia Bayleyana F. v. Muell. Trans. et Proc. Roy. Soc. Vict. 24:168. 1888.

This species is only planted in the uplands; it is not common, in fact it is of rather recent introduction. Flowering specimens occur in Mr. W. M. Giffard's place, Kalanilehua, near the Volcano of Kilauea, at 29 miles, Hawaii.

Acacia cornigera Willd. Spec. plant. edit. quart. 4:1080. 1805.
Mimosa cornigera Linn. Spec. plant. 1:520. 1753.

To this species must be referred a plant growing in Mrs. M. E. Foster's garden on Nuuanu Street. A tree of apparently this much confused species was cut down and young shoots have grown from the old trunk. In absence of flowers and fruits the determination remains doubtful.

LEUCAENA Bentham

Flowers 5-merous, sessile, usually hermaphrodite. Calyx tubular-campanulate, dentate. Petals free; stamens 10, exserted; ovary stipitate, many-ovuled. Style filiform. Pod stipitate, broadly-linear, compressed stiff-membranods, 2-valved, not septate. Unarmed trees or shrubs with bipinnate leaves. Leaflets samll multi-jugate. Flowers white, arranged in axillary fasciculate heads.

Nine species, 7 natives of Western America, one of the Pacific Islands.

A single species escaped from cultivation, or of accidental introduction, common in Hawaii. *L. glauca*.

Leucaena glauca Benth. in Hook. Journ. Bot. 4:416. 1842.
Mimosa glauca Linn. Spec. Plant. 1:520. 1753.

Koa haole.

Plate 18.

A shrub or small tree 2 to 6 m tall; leaves 15 to 25 cm long; the rhachises pubescent; pinnae 8 to 16, 5 to 9 cm long; leaflets 20 to 30, linear oblong, acute inequilateral, 7 to 12 mm long; heads solitary, axillary long peduncled globose, densely many-flowered, 2 to 5 cm in diameter; flowers white; pod thin flat, strap-shaped, acuminate, 12 to 18 cm long, 1.4 to 2 cm wide, usually many developing from each head of flowers, each containing from 15 to 25, elliptic compressed, shining brown seeds.

A native of tropical America, but now found all over the tropics.

The *Koa haole*, as the natives of Hawaii term this species, is now one of the widest distributed plants throughout Hawaii. It occurs only in the lowlands of both leeward and windward sides.

Horses feeding on this plant lose the hair of their manes and tails.

PLATE 19.

DESMANTHUS VIRGATUS Willd.

It is usually a shrub, but often attains the size of a small tree. In the West Indies the seeds, when ripe, and the pods, when young, are eaten raw with rice. In the Philippines the species has been planted as a preliminary to reafforestation in lands taken possession of by Cogon grass.

MIMOSA Linnaeus

Flowers 4-merous small, in dense globose heads, polygamous. Calyx campanulate, short-toothed. Petals connate below. Stamens as many as or twice the number of the petals, much exserted; anthers not gland-crested. Ovary stipitate. Pod flat membranous, made up of 1-seeded joints that separate from the sutures on maturity. Herbaceous prickly plants with bipinnate, sensitive leaves, the leaflets small.

About 300 species in tropical and subtropical America, few in Asia and Africa. Absent in Australia. Only the cosmopolitan *Mimosa pudica* found naturalized in Hawaii.

Mimosa pudica Linn. Spec. Plant. 1:518. 1753.

Sensitive Plant.

A diffusely spreading, suffrutescent herb, the stems branched, up to 1 m in length, sparingly prickly, and with numerous deflexed bristly hairs. Leaves very sensitive, both the pinnae and the leaflets falling when touched; pinnae usually 4, digitately arranged at the end of each petiole, 4 to 9 cm long; leaflets narrowly oblong, inequilateral, acute, 1 to 1.5 cm long, sessile, sparingly bristly; heads long peduncled solitary or 2 or 3 in each axil nearly 1 cm in diameter; flowers pink, very numerous; stamens 4; pods flat, slightly recurved, numerous, 1 to 2 cm long, made up of from 3 to 5, 1-seeded joints that at maturity fall away from the persistent, armed sutures which bear numerous, weak, spreading, yellowish-white bristles.

A native of tropical America, but now found in all tropical countries; it is a common pest in agricultural land throughout Hawaii, and is especially obnoxious in cane fields.

Mimosa rubicaulis Lam. DeCand. Prodr. 2:429. 1825.

Plants of this species are not established in the Territory. Several were grown from seed which the writer brought with him from Java. The plant is quite prickly, and therefore may be objectionable. It is a shrub or low tree, and a native of the western Himalayas ascending from sea-level to 5000 feet; it occurs also in Afghanistan and throughout the greater part of India.

The wood is used for making gunpowder charcoal. It is usually planted as a hedge on account of its forming an impenetrable thicket.

DESMANTHUS Willdenow

Flowers pentamerous, sessile, hermaphrodite or the lower partly male or asexual; calyx campanulate, short-toothed; petals free or slightly adhering; stamens as many or twice as many as petals, free exserted; ovary subsessile, many-ovuled. Pod linear, straight or curved, flat compressed, valves at dehiscence separating at the sutures. Seeds transverse or oblique.

Perennial herbs or suffrutescent herbs with bipinnate leaves and small leaflets; stipules bristle-like, persistent. Flowerheads single in the leaf axils, subglobose often few-flowered.

A genus of 9 species natives of subtropical North America one species native of Madagascar.

Desmanthus virgatus Willd. Spec. pl. edit. quarta 4:1047. 1805.

Mimosa virgata Linn. Spec. Pl. 1:519. 1753.

Plate 19.

Stems woody at the base 0.5-1.3 m high, branches virgate angular, scabro-puberulous, otherwise glabrous; stipules setiform, 4-6 mm long, common petiole 2.5-5 cm long; gland ovate elliptical, between the two lower pair of pinnae, pinnae 2-5, distant from each other, 2.5-3.5 cm long; leaflets oblong- linear, 4-6 mm long, broader at the apex, obtuse and mucronate, obscurely glandular, one-nerved, uneven-sided at the base; peduncles axillary, solitary 2.5-7.5 cm; head ovate-globose, small, 6-10-flowered; bracts setaceous; flowers glabrous, white; calyx membranous, 2 mm long, shortly dentate; petals one-holf longer than the calyx; stamens twice as long as petals; anthers without glands; ovary sessile glabrous; legume usually 5-8 cm long, 3 mm wide, linear, shining, erect or subfalcate; seeds up to 20 or more, ovate-polygonous.

OAHU: Nuuanu Valley, Judd Street, Wyllie Street, Nuuanu Avenue, in Dr. Hillebrand's-Mrs. Mary E. Foster's grounds.

Desmanthus virgatus is a native of tropical and subtropical America, but is widely diffused over the tropics in general as in India and Africa (Congo). In the Hawaiian Islands it has made its appearance more or less recently. It is not mentioned by Hillebrand in his Flora. So far the plant has only been observed in Nuuanu Valley. It forms a hedge in Mrs. Mary E. Foster's grounds on the makai side of her property. Scattered it occurs on Wyllie Street and Judd Street.

As the plant is a prolific seeder it is expected that it will be soon found elsewhere in cultivated and waste places on Oahu. Though not thorny, the plant is apt to become a nuisance in cultivated areas.

No. 12862 in Herb. College of Hawaii.

Desmanthus virgatus provides an excellent fodder though the foliage is small and scanty. It was analyzed by Sornay, who found the following constituents:

Water	68.70	per cent
Ash	2.28	" "
Cellulose	13.21	" "
Fat	0.77	" "
Non-nitrogenous matter	11.29	" "
Nitrogenous matter	3.75	" "

PROSOPIS Linnaeus

Flowers pentamerous, usually sessile; calyx campanulate, short-toothed. Petals connate below the middle or later free; *stamens* 10, *free*, shortly exserted. Ovary sessile or stipitate with many ovules. Style filiform with terminal small stigma. Pod linear, compressed or subterete, straight or somewhat falcate, indehiscent, with thin to coriaceous exocarp, thick, pulpy mesocarp and chartaceous endocarp, the latter forming septa between the seeds. Seeds ovate, compressed. Armed or unarmed trees or shrubs, with bipinnate leaves. Flowers small, in axillary cylindrical spikes.

About 25 species in the tropical and subtropical regions of both hemispheres.

Prosopis juliflora is the only species of the genus in Hawaii, where it is the most common lowland tree, of great value. It is of early introduction.

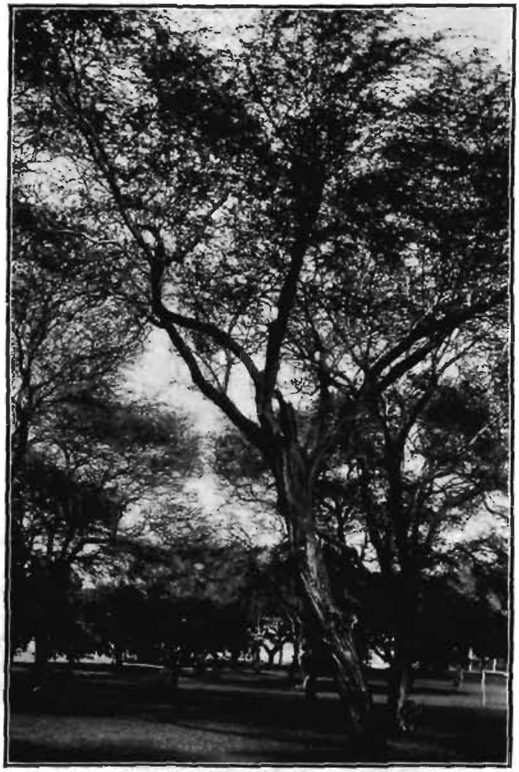
Prosopis juliflora (Sw.) DC. Prodr. 2:447. 1825.
Mimosa juliflora Swartz Prodr. 85. 1788 error typograph. *piliflora*.
Acacia juliflora Willd. Spec. Pl. 4:1076.
Mimosa salinarum Vahl Ecl. 3:35. 1807.
Desmanthus salinarum Steud. Nom. Bot. ed. 1. 1821.
Acacia salinarum DC. Prodr. 2:456. 1825.
Prosopis horrida Kunth. Mim. 106. t. 33. 1819.
Prosopis dulcis Kunth. Mim. 110. t. 34. 1819.
Algarobia dulcis Benth. Pl. Hartw. 13. 1839-1857.
Prosopis inermis H. B. K. Nov. Gen. et Sp. 6:306. 1823.
Prosopis glandulosa Torr. in Am. Lyc. N. York 2:192. 1828.
Prosopis odorata Torr. in Frem. Rep. 313. t. 1. exl. fr. 1845.

Algaroba.

Plate 20.

A tree 10 to 20 m tall, branches glabrous or minutely puberulous; stipules small setaceous or aristate, sometimes obsolete; spines axillary, solitary or in pairs, straight, in sterile branches up to 5 cm long, divaricate, sometimes very short or entirely absent; leaves glabrous or rarely pubescent, distant or in short branchlets, subfasciculate, common petiole 12 to 50 mm; glands often small between the pinnae, and smaller between leaflets; pinnae often 1-jugate; rarely 2-jugate, very rarely 3-jugate, rhachis 3.25 to 7.5 cm; leaflets broadly oblong 4 to 16 mm long, or linear 12 mm to 2.5 cm long, with all intermediate forms, straight or falcate, obtuse or pointed, the costa somewhat prominent beneath; inflorescence spicate, axillary, or fasciculate with the leaves, shortly pedunculate 5 to 10 cm long, dense or slender and subinterrupted; bracts minute; flowers glabrous outside or with few short scattered hair, 3 mm long; calyx 1 mm long, the opening often ciliate; petals often woolly inside at the apex; stamens half

PLATE 20.



PROSOPIS JULIFLORA (Sw.) DC.
Algaroba Trees on Punahou Campus.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

as long again as the corolla; ovary shortly stipitate. villose; pod more or less arcuate or nearly straight 5 to 15 cm long, 4 to 12 mm wide, before maturity often flat compressed, at maturity on both sides more or less convex, continuous outside, or between the seeds marked with depressions of transverse lines, mesocarp more or less spongiose, endocarp hard, often bony.

Exceedingly variable as to stature, spines, number of leaflets and size of pod.

A native of Brazil, Montevideo, indigenous and cultivated in Argentine, Chile, Peru, Bolivia, Columbia, Central America, Mexico, Texas and the West Indies. Cultivated and naturalized in Hawaii.

The *Algaroba* is by far the most common as well as the most valuable of all the introduced trees in the Hawaiian Islands. No tree so far introduced has proven of such enormous benefit to these islands as the *Algaroba*. It is an exceedingly variable species, as trees occur bristling with spines, and others again are perfectly unarmed. Its natural distribution ranges from the West Indies to the southern United States, Central America, and even to South America, Brazil and Peru. All the waste lands in these islands, which previously to the introduction of this valuable tree were absolutely barren, are now covered with green forests made up exclusively of this tree. The tree was introduced by Father Bachelot in 1828, the seed having come from the Royal Gardens at Paris, France. For further discussion on the history of this tree in Hawaii, the writer would refer the reader to his book, "The Ornamental Trees of Hawaii," page 89.

Very recently the U. S. Experiment Station has grown several species of *Prosopis* from imported seed; their identification is so far doubtful.

ADENANTHERA Linnaeus

Flowers hermaphrodite or polygamous, 5-merous, shortly pedicelled. Calyx campanulate short-toothed; petals connate below the middle or free; stamens 10, free hardly exserted; anthers gland-tipped. Ovary sessile, many-ovuled. Pod linear, curved, compressed, 2-valved, with usually convex finally twisted valves. Seeds thick with a hard, scarlet testa. *Unarmed trees with* bipinnate leaves and small multi-jugate leaflets. Flowers white or yellowish in axillary catkin-like racemes.

A genus of about 3 species natives of tropical Asia. Only one species, *A. pavonina,* in cultivation in Hawaii.

Adenanthera pavonina Linn. Spec. Pl. 384. 1753.

False Wiliwili.

A deciduous unarmed tree. with hard. red heartwood; leaves bipinnate, pinnae opposite 4-6 pair, leaflets evenly alternate 12-20, elliptic oblong, obtuse 2.5 cm long; flowers small, yellow, fragrant, on slender pedicels in long panicled racemes; calyx small, campanulate, teeth short; petals 5, connate at the base; stamens 10, free, anthers tipped with a deciduous gland; pods linear, curved and twisted when opening, 10-22.5 cm long; seeds bright scarlet, shining, compressed.

Adenanthera pavonina is commonly known in Honolulu as *Wiliwili*, but has nothing to do with the tree to which the name *Wiliwili* is applied by the natives.

The tree in question is a native of India, Malay Archipelago, China, the Andaman Islands, and extends into the subhimalayan tract of Northern India.

The leaves as well as the seeds are employed medicinally in India. The hard and close-grained wood is used in the preparation of a dye which is employed as a substitute for that of the red Sandalwood, (*Pterocarpus Santalinus*).

The timber is used for house building, and may also be employed for fence-posts as it is very durable and strong. The seeds form also an article of food.

ENTADA Adanson

Flowers sessile, 5-merous; calyx campanulate, very shortly toothed; petals free or slightly cohering; stamens 10, free, short exserted; ovary sessile, many ovuled. Pod straight or curved, very large, compressed, coriaceous or woody with thickened persistent sutures, the valves separating in one-seeded joints. Endocarp enclosing the seeds and separating from the exocarp. Seeds orbicular. Unarmed tall climbing shrubs with bipinnate leaves; leaflets rather large. Flowers small in thin, short or elongate, solitary or 2, somewhat paniculate racemes, either terminal or the lower axillary.

A genus of 11 species, of which 7 occur in tropical Africa, 3 in tropical America, and 1 in the tropics of both hemispheres. On a recent exploring trip through the mountains of Kauai, the writer found this species wild in the mountains back of Lihue. This is the first record of it occurring in the Hawaiian Islands.

Entada scandens (Linn.) Benth. in Hook. Journ. Bot. 4:332. 1842.
Mimosa scandens Linn. Sp. Pl. ed. 2:1501. 1763.

Entada scandens, known as Gogo in the Philippines (Luzon), is a huge climber or liana. It reaches enormous dimensions, and pods four feet in length, while the flowers are only one-eighth to one-twelfth of an inch long. It is widely distributed, and is considered a cosmopolitan in the tropics. In the Himalayas it grows up to an elevation of 4000 feet, but descends down to sea-level. Seeds were imported by the writer from Java, the Philippines, and Darjeeling in the Himalayas; they were germinated successfully by Dr. H. L. Lyon. Young plants thus secured for the first time in Hawaii, were planted against large algaroba trees on the College of Hawaii grounds, and also on Dr. Lyon's premises. In Ceylon the bark of this plant is used for cordage and ropes. It is reported that the large pods are used by the police in the West Indies for clubs. The writer saw the natives (Nepalese) at Darjeeling (Himalayas) using the seeds, which they scooped out on one side, for crimping linen, by introducing two fingers into the cavity and quickly stroking the damp linen with the polished surface. The seeds, which are very large, flat and round in outline, are made into snuff and match boxes. In February, 1920, the writer found this species wild on the Island of Kauai, in the mountains back of Lihue, along the Pole-line trail. Mr.

V. W. Hardy, who mentioned this vine to the writer, said that a cow had been found strangulated by the long rope-like stems of this plant. It is a huge climber, occurring at an elevation of about 900 feet, and covers a large area, entangling several trees. It was neither in flower nor in fruit, but leaf-specimens are identical with those grown in Honolulu from imported seed. There is no question as to the identity of this species.

PARKIA R. Brown

Flowers in dense, long-peduncled obovoid heads. Calyx tubular, shortly 5-cleft, the lobes imbricate. Corolla tubular, somewhat cleft. Stamens 10, exserted, the filiform filaments in the lower part united with each other and with the corolla tube. Anthers gland-tipped. Ovary stalked. Pod large, flat, strap-shaped, coriaceous, very tardily dehiscent. Tall unarmed trees with evenly bipinnate leaves, the leaflets very numerous small.

A genus of about 10 species in the tropics of both hemispheres.

Three species have been recently introduced into Hawaii by the writer.

Parkia timoriana* (DC.) Merrill in Phil. Journ. Scie. 5:1, 32. 1910.
Inga timoriana DC. Prodr. 2:442. 1825.
Mimosa biglobosa Roxb. Fl. Ind. 2:551. 1832. Non Jacq.
Parkia Roxburghii G. Don Gen. Syst. 2:397. 1832.

Only two trees of this species have reached maturity in these islands; both of them occur on the island of Maui. The oldest and largest one occurs in the grounds of Mr. Penhallow, manager of Wailuku Sugar Co. The writer has not seen flowering specimens, but has received leaves and old flower stalks, as well as mature pods. The plant was known on Maui erroneously as *Albizzia moluccana*. It has, however, nothing in common with the species of that name. There seems to be some controversy regarding the nomenclature of the species in question, which seems to have been solved by Merrill. However, *Parkia africana* is, according to Oliver, a synonym of *Parkia biglobosa* Benth. which in turn is quoted as a synonym of *Parkia Roxburghii* G. Don, both of which are synonymous or identical with *Inga timoriana* De Cand.

Hillebrand, in his "Flora of the Hawaiian Islands." mentions *Parkia africana* as growing here as an introduced species. Trees on Maui are the only ones known to the writer. The differences between the typical *P. Roxburghii* and *P. timoriana* are certainly slight, and are practically restricted to the leaflets which are very glabrous on both sides, but have ciliate margins in the first species, and leaflets pubescent on both sides in the second species. That the above characters cannot be relied upon is shown by the Hawaiian grown specimens which have leaflets pubescent above and glabrous underneath, and have also ciliate margins.

The writer has quite a number of plants set out on the College grounds. They

*Merrill has recently changed this name to **Parkia javanica** (Lam.) Merrill.

were grown from seed introduced by him from the Philippines. He has also plants grown from seeds received from the Botanic Gardens of Ceylon and Calcutta under the names of *Parkia biglobosa* and *Parkia africana*.

Parkia timoriana is a magnificent tree reaching a height of 90-100 feet with straight boles several feet in diameter. The writer has seen splendid specimens growing wild along the Limao River and in Limao forest reserve, Luzon, Batan Province, P. I. It is a rapid grower, and is well worth to be more generally cultivated, as it is an excellent shade tree. Dr. H. N. Whitford describes the tree as follows:

It reaches a height of 35 to 40 m (120 feet) and a diameter of 150-180 centimeters (72 inches). The bole is up to 60 feet in length, and the crown is one-half the height of the tree, wide-spreading and open. It prefers good soil and requires a great deal of light, and is found usually in open places. The wood may be used for light and temporary construction, packing boxes, wooden soles of shoes and matches. It is also known to be good for paper pulp.

Parkia biglandulosa Wight & Arn. Prodr. Florae Penins. Ind. orient. 1:279. 1834.

This species is as yet not established in the islands; plants were grown at the College of Hawaii Nursery from seeds introduced by the writer. They have been planted out on the College grounds. It is a native of the Malay Peninsula, but is now widely cultivated. It is of a similar habit as *Parkia timoriana*. The name *biglandulosa* refers to the two glands at the base of the petiole instead of a single one, as is the case with the other species.

Seeds had also been introduced some years ago by Dr. H. L. Lyon. They were turned over to the Board of Agriculture, but no one seems to know if they were grown or planted, or if they perished. This, and the foregoing species, can be recommended for planting in the lowlands on the leeward side of the islands near plantation camps or open lands. In the lower forests, it would do well where the *kukui*, *Aleurites moluccana* thrives.

CAESALPINIOIDEAE.

Flowers zygomorphic, symmetrical, rarely subactinomorphic, pentamerous, rarely tetramerous. Sepals 5 or 4, free to the more or less developed receptacle, rarely united, imbricate in the bud, rarely valvate. Petals 5, or less through abortion, rarely wanting, the upper the innermost in the bud, the remaining variably imbricated. Stamens 10, or less through abortion, free or more or less united; anthers variable. Ovary free, sessile or adhering more or less to the receptacle by a stipe. Seeds variable, with rich, sparse or wanting albumen. Trees, shrubs or rarely herbs with pinnate or twice pinnate leaves, rarely simple leaves (*Bauhinieae*). Pinnae 1-multijugal. Stipules always present. Flowers variable, large and very showy or small and insignificant, in racemes or spikes, axillary or terminal and united to panicles or cymes. Pods indehiscent or dehiscent.

The subfamily *Caesalpinioideae* is represented in the Hawaiian Islands by eighteen genera, of which thirteen are represented by mature and well established plants; the remaining five genera are new introductions to the Territory, and include some of the finest flowering leguminous trees known. The finest flowering tree, *Amherstia nobilis,* introduced by the writer from Java, has unfortunately died.

Noteworthy are: *Brownea hybrida, Colvillea racemosa, Schizolobium excelsum, Lysidice rhodostegia, Pahudia rhomboidea* and a species of *Sindora.*

KEY TO CAESALPINIEAE.

Calyx undivided in the bud, or segments united in the upper half of the receptacle into a short tube which is lobed or dentate at the apex; tube splitting irregularly at flowering or apparently split into distinct segments.
  Leaves not pinnate but simple, two-lobed, deeply divided to the base and apparently uni-jugate; stamens 10 or less .... **Bauhinieae**
Calyx segments free even in the bud almost to the base.
  Leaves bipinnate .... **Eucaesalpinieae**
  Leaves *pinnate.*
    Anthers basifixed, opening in terminal pores .... **Cassieae**
    Anthers dorsifixed, opening in lateral longitudinal slits ...... **Amherstieae**

Bauhinieae.

Leaves simple, entire, two-lobed or more or less united, rarely composed of two leaflets. .... **Bauhinia**

Eucaesalpinieae.

All stamens of nearly equal length, and fertile.
  Upper calyx segments not united.
    Common petiole very short terminating in a thorn; rhachis of pinnae very long resembling a phyllodium .... **Parkinsonia**
    Common petiole distinctly developed, not phyllodium-like.
      Calyx segments valvate, flowers large, trees with very numerous small leaflets. .... **Delonix**
      Calyx segments imbricate, ovary 2-many ovuled; scandent or erect, armed or unarmed.
        Scandent or erect shrubs or small trees, usually armed, pods not winged. .... **Caesalpinia**
        Tree, unarmed, pods thin winged along the upper suture .... **Mezoneuron**
        Large tree with subequal calyx segments, pod narrowly winged along both sutures .... **Peltophorum**

Cassieae.

Flowers with strongly dilated disc .... **Ceratonia**
Flowers without such disc.
  Leaves pari-pinnate, flowers yellow or pink, small or large, trees or bushes .... **Cassia**

Amherstieae.

Petals missing, leaves pari-pinnate, flowers in lateral paniculate corymbs .... **Saraca**
Petals five, rarely two or three only rudimentarily present.
  Leaves uni-jugate, petals 5-3, stipitate, pod thickly warty .... **Trachylobium**
  Multi-jugate, petals 3 the two lower rudimentary; fertile stamens 3 with short filaments .... **Tamarindus**
Uppermost petal very large long stipitate, the other four entirely rudimentary, fertile stamens free 3-8, the other reduced to staminodia .... **Intsia**

PLATE 21.

SARACA INDICA Linn.
Asoka or Sorrowless Tree.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

SARACA Linnaeus

Calyx with prolonged receptacle and four petaloid ovoid, subequal segments. Petals wanting. Stamens 3-9, free with prolonged filaments. Ovary stipitate with many ovules; style filiform with terminal obtuse stigma. Pod oblong, flat, compressed, coriaceous or almost woody, two-valved. Seeds flat, rarely nearly cylindrical or globose, without arillus and albumen. Unarmed trees with paripinnate leaves; leaflets in few pairs, coriaceous. Stipules small, caducous. Flowers yellow, pink or scarlet in short many branched, paniculate racemes.

Eight species are known as belonging to this genus; their home is in tropical Asia.

There are two species in cultivation in the islands, one introduced by Dr. W. Hillebrand, *Saraca indica*, and a second species, *S. declinata*, was recently introduced by the writer from the Buitenzorg Gardens in Java.

Saraca indica Linn. Mant. 1:98. 1767.
Jonesia Asoca Roxb. As. Res. 4:355. 1795.

Asoka or *Sorrowless Tree.*

Plate 21.

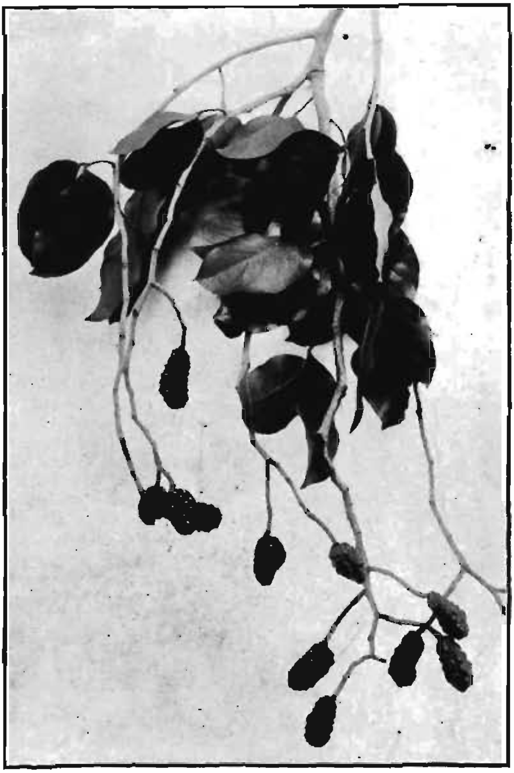
A low erect tree up to 10 m high; branches glabrous, cylindrical; leaves on a common petiole of 14 to 20 cm; leaflets 6 to 12, oblong or oblong lanceolate, acute or obtuse, 7.5 to 22.5 cm long, 5 to 7 cm wide, rigidly subcoriaceous; petiolule short, glabrous; stipules small, laciniate at the apex, caducous; inflorescence a dense corymb axillary, globose, 7 to 10 cm in diameter; bracts ovale; bracteoles 2, persistent ascending; pedicels stout, 7 to 12 mm long; calyx tube 12 to 15 mm long, cylindrical, lobes 4, obovate-oblong, 6 to 7 mm long; petals none, stamens 7, rarely 8, anthers twice as long as broad; filaments three times as long as the sepals; ovary puberulous along the margins; style filiform; ovules 6 to 8; pod blackish, 9 to 24 cm long, 4 cm broad, linear-oblong, stalk about 6 mm; seeds 4 to 8, compressed, oblong, about 35 mm long.

The Asoka or Sorrow-less tree is a native of India, the Malay Isles, and Ceylon. It occurs in the central and eastern Himalayas up to an elevation of 2000 feet.

It is now widely cultivated on account of its beautiful coral-red flowers which are arranged in large globose heads. In Hawaii the tree is sparingly cultivated. Only very few trees are in existence, as in the Government Nursery grounds, Mrs. Mary E. Foster's premises, St. Louis College grounds, and probably elsewhere. The tree is held sacred by the Burmese, who believe that Buddha was born under its shade. It is also sacred to the Hindus, who are ordered to worship it on a certain day in the year. The wood is rather soft and of a light reddish brown color; the heartwood is hard, and dark colored.

Besides *Saraca indica* there is also in cultivation at the College of Hawaii campus a single specimen of *Saraca declinata* Miq. a very handsome tree with large heads of orange red flowers. The species was introduced by the writer from Java in 1916. It is a native of Sumatra.

PLATE 22.



TRACHYLOBIUM VERRUCOSUM (Lam.) Bak.
Copal.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Saraca declinata Miq. Fl. Ind. Bat. 1[1]:84. 1855.
Jonesia declinata (Jack.) Hassk. Retzia 1:196. 1855.

A small tree; leaves about 70cm long, long-petiolate, petiole 1 to 7 cm long, glabrous membranaceous to coriaceous, a deep green and shining above, paler beneath; young leaves pendulous, pale pink or white; petiolule 8 mm long, 3 mm thick; leaflets 6 to 9, often only 7; lower ones ovate, often rounded at the base 30 to 20 cm long, the others oblong, acuminate, 18 to 36 cm long, 5 to 13 cm broad; inflorescence axillary or terminal, corymbose-racemose, all parts orange yellow, 30 to 40 cm broad; bracts ovate, acute; bracteoles oblong, acute; pedicels short; stamens 4, filaments reddish, with 4 dentiform alternate staminodia; pod linear, straight or subfalcate, 26 to 30 cm long, 5 to 6 cm broad. At first pale purple, black at maturity; seeds compressed the shape variable and many-angled.

A native of central and western Java; also Sumatra. It is a very beautiful tree, much more so than *S. indica*, from which it differs in the larger leaves and also much larger inflorescence measuring a foot in diameter.

A specimen is growing at the College of Hawaii grounds. It was introduced by the writer from Buitenzorg, West Java, in 1916.

TRACHYLOBIUM Hayne.

Calyx with a narrow turbinate receptacle and four segments. Petals five, the three upper usually clawed, suborbicular and subequal, the two lower small scale-like, or sometimes all clawed and subequal. Stamens 10, free; filaments slightly frimbriate at the base. Ovary shortly stipitate, with few ovules. Style filiform with small terminal stigma. Pod ovate-oblong, thick coriaceous, warty, indehiscent. Seeds thick without arillus and albumen. Unarmed trees with one-paripinnate leaves, leaflets coriaceous, more or less transparently punctate. Flowers white in long racemes on terminal branchlets.

A genus of three species; two are known from tropical Africa and the Mascarene Islands, and one from tropical Asia.

Besides *Trachylobium verrucosum*, of which a few mature trees are in the territory, *T. Hornemannianum* was introduced from tropical Africa, but if established is doubtful.

Of *Hymenaea*, a genus closely related to *Trachylobium*. The Board of Agriculture received, several years ago, seeds of *H. Courbaril* Linn., the American Copal Tree, from the West Indies. If they were planted or have been set out cannot be ascertained.

The writer collected seeds of this species during his recent trip to the Orient in the economic gardens at Singapore. They were turned over to the Hawaiian Sugar Planters' Experiment Station Nursery on Nuuanu Street, where they have already germinated and are now ready to be planted out.

Trachylobium verrucosum (Lam.) Baker in Flora Maur. & Seych. 88. 1877.
Hymenaea verrucosum Lam. Ill. t. 330, fig. 2. 1791-1823.

Madagascar Copal.

Plate 22.

A tall unarmed tree, with terete branches; leaves short-petioled, consisting of a single pair of oblique, oblong, rigidly coriaceous glabrous, pointed leaflets 5-7.5 cm long, cuneate at the base on the inner, rounded on the outer side; flowers arranged in an ample corymbose panicle, the lower branches of which often spring from the axils of the leaves; branchlets pilose; calyx limb 6 mm long, the segments oblong, obtuse, tomentose on the back; petals white, the three upper often exserted from the calyx, rounded, with a distinct claw; pod oblique, oblong, warty, obtuse 5 cm long.

A native of Madagascar, the Seychelle Islands, and East tropical Africa.

Represented in Hawaii perhaps only by a single mature, bearing specimen, which can be found in the Government Nursery grounds on King Street. Specimens have been grown from seed introduced by the writer from Java, and have been planted at the College of Hawaii grounds.

Trachylobium verrucosum furnishes the so-called Madagascar Copal. The resin is obtained from the bark, but the natives of Madagascar prefer to gather the hard semi-fossil copal accumulated at the foot of large trees. Copal is mainly employed in the production of varnishes.

Trachylobium verrucosum is closely related, if not identical, with *Trachylobium Hornemannianum*, which produces Zanzibar Copal.

The resin exudes from the trunk and large branches. The specific name "*verrucosum*" refers to the resinous tubercules on the pods which are well brought out in the accompanying illustration.

SCHOTIA Jacq.

Calyx with turbinate, short or at the base attenuate receptacle and four segments. Petals 5, subequal, subsessile, ovate or oblong, small and scale-like. Stamens 10, free or shortly united at the base. Ovary stipitate, many-ovuled; style prolonged, with small terminal stigma. Pod oblong or broad, linear or ovate, sometimes drepaniform, flat-compressed, coriaceous, nearly indehiscent, margined at the upper suture. Seeds orbicular, without albumen. Funiculus developed into a fleshy, cup-shaped arillus. Unarmed small trees or shrubs with paripinnate leaves and large or small coriaceous leaflets. Flowers bright red in short panicles.

A genus of six species peculiar to tropical and southern Africa.

The writer has introduced two species, *Schotia latifolia* Jacq. and *S. brachypetala*. Both species are cultivated in southern California, whence they were introduced to Hawaii, in 1917.

KEY TO THE SPECIES.

Flowers on longish pedicels, petals minute hidden in the calyx ... **Schotia brachypetala**
Flowers subsessile, petals larger and longer than calyx .... **Schotia latifolia**

Schotia brachypetala Sond. in Linn. 23:39. 1850.

A large shrub or small tree, sometimes blossoming from the trunk or large branches; leaves 4 to 5-jugate; leaflets large ovate-oblong, or obovate, obtuse, netted-veined 18 mm to 6.25 cm long, 12 mm to 3.75 cm wide, sometimes cuneate or tapering; sometimes truncate at the base; panicles axillary and terminal many-flowered; flowers pedicellate; calyx tube conical; petals very minute, linear, hidden under the calyx-lobes; the calyces and peduncles rich crimson; stamens monadelphous; ovary on a long stipe.

This species is a native of South Africa, inhabiting the regions of Port Natal, where it is rather rare. Living specimens were introduced by the writer from Southern California, and they have already been planted out at the College of Hawaii grounds. Both this species and *Schotia latifolia* are very symmetrical trees with a globose crown reaching to the ground. It is worthy of cultivation on account of the beautiful crimson inflorescence.

Schotia latifolia Jacq. Fragm. 23, t. 15, f. 4. 1809.

A tree 7 to 10 m high; leaflets variable in shape; leaves 2 to 4-jugate; leaflets large, obovate-oblong, obtuse, coriaceous, 3.75 to 6.25 cm long, 12 to 25 mm wide, glabrous, rigid and thick. Panicles axillary and terminal, much-branched, densely many-flowered; flowers subsessile; calyx tube very short; petals longer than calyx; flowers rose or flesh-colored; stamens monadelphous; pod 1 to 3-seeded, 3.75 to 10 cm long, 3.75-5 cm wide, very rigid; each seed sitting in a cup-like, yellow, fleshy arillus.

A native of South Africa, where it is not uncommon in the woods of Albany, etc. The tree was introduced into Hawaii by the writer from Southern California, where it is in cultivation. Besides living specimens, seeds were secured by him in Santa Barbara, and numerous seedlings were grown. Specimens have been planted at the College of Hawaii grounds. The tree seems to be well suited for dry districts. In South Africa, the roasted pods are eaten.

TAMARINDUS Linnaeus

Calyx with narrow turbinate receptacle and four membranous segments. The three upper petals subequal, the uppermost somewhat narrower and shortly clawed, the two lower small, bristle or scale-like. The three fertile stamens united to near the apex into a sheath split above; staminodia small, at the apex of the sheath. Ovary stipitate, many-ovuled. Style prolonged with terminal, truncate-capitate stigma. Pod linear-oblong, subfalcate, thick, somewhat compressed, indehiscent, with thin, fragile epicarp, pulpy mesocarp and thick leathery endocarp, septate between the seeds. Seeds obovate-circular, compressed, without albumen. An unarmed tree with paripinnate leaves and multi-jugal, small leaflets. Flowers yellowish marked with red, in terminal racemes.

Only a single species in the genus, in all probability a native of tropical Africa. The Tamarind, now widely distributed and planted in the tropics of both hemispheres.

PLATE 23.

TAMARINDUS INDICA Linn.
Tamarind.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Tamarindus indica Linn. Spec. Pl. 34. 1753.

Tamarind.

Plate 23.

A large tree 12 to 20 m high, nearly glabrous; leaves even-pinnate, 6 to 10 cm long; leaflets 20 to 40, rather close, oblong, obtuse, 1 to 2 cm long; racemes mostly axillary, sometimes panicled, 5 to 10 cm long; calyx about 1 cm long; petals yellowish with pink stripes, obovate-oblong, less than 1 cm long; pods oblong, thickened 6 to 15 cm long, 2 to 3 cm wide slightly compressed, the epicarp thin, crustaceous, the mesocarp pulpy, acid, edible.

The Tamarind is probably a native of tropical Africa, but is now cultivated in all tropical countries. The leaves, flowers, and fruits contain a quantity of acid, are employed as a dye in conjunction with other dye-producing flowers in India. An oil is expressed from the seeds, which is of a beautiful amber color, and sweet to taste. It has been advocated for culinary purposes as well as for the preparation of varnishes and paints. As a medical plant the value of the tamarrind was well known in the remote period of Sanskrit medicine and was made known to the Arabs through the Hindus.

The name *Tamarind* is derived from the Arabian *Tamare-Hindi*, meaning Indian date. The fruit is an excellent purgative and was known in Europe from the middle ages. It is now officially recognized in Europe and America as a valuable laxative, and as a refrigerent in fever. As a food it is used in curries and chutneys. The wood is yellowish-white, hard and rather close grained; the heartwood is comparatively small and dark purplish brown in color. It is highly prized, but difficult to work, and is employed in India mainly for wheels, mallets, furniture, etc. The tree is well adapted for dry districts, but is of rather slow growth.

INTSIA Thouars

Calyx with elongate receptacle and four subequal segments. Petals one, clawed, orbicular or reniform, the remaining ones either rudimentary or wanting altogether. Stamens 3-8, free, deflexed, with elongate filaments; staminodia 2-4, small or wanting. Ovary stipitate, many-ovuled; style elongate, with truncate, subcapitate stigma. Pod obliquely-oblong, compressed, thick, coriaceous or almost woody, 2-valved or hardly dehiscent, septate between the seeds. Seeds ovate or orbicular or oblong, with or without arillus and without albumen. Unarmed trees with paripinnate leaves, leaflets few, coriaceous. Flowers rather large at the ends of branchlets in paniculate racemes. A genus of seven or eight species natives of tropical Africa or Asia.

One species, *Intsia bijuga*, is cultivated at the St. Mary's School in Hilo. Seeds of another species, a native of Africa, with bright yellow arillus, were introduced by the H. S. P. A. under the name Bembikofe. If established is doubtful.

Intsia bijuga (Colebr.) O. Kuntze Rev. Gen. Pl. 192. 1891.
Macrolobium bijugum Colebr. Trans. Linn. Soc. 12:359, t. 17. 1817.
Afzelia bijuga A. Gray Bot. U. S. Expl. Exped. 467, t. 51. 1854.

A tree 15-20 m in height, trunk 30 to 50 cm in diameter; branches cylindrical, pale, quite glabrous; leaves 7 to 14 cm long; common petiole 1-5 cm long, robuste, glabrous; leaflets 2 to 6, opposite, broadly elliptical, rounded and emarginate at the apex, somewhat oblique at the base, 8-15 cm long, 5-10 cm broad, coriaceous, glabrous; the corymbose or paniculate racemes terminal or leaf-opposed, finely pubescent, 6 to 10 cm long; calyx pubescent, the tube 8 mm long; lobes 4, ovate-oblong, 11 to 13 mm long; petals 1, orbicular-reniform, 13 mm long, 15 mm broad, quite pubescent, white or pink; stamens 8, 3 fertile; anthers oblong, the sterile ones much shorter and without anthers; ovary stipitate, pubescent on both sutures, exserted; pod 10 to 25 cm long, 4 to 6.5 cm wide, thickly coriaceous, 3 to 6-seeded; seeds 25 mm in diameter, orbicular, compressed, brown.

A widely distributed species from the tropical shores of Madagascar through Malaya, Philippines, tropical continental Asia, the Caroline Islands, and Fiji.

In Hawaii the writer knows of only one mature bearing tree. It can be fonnd in the grounds of St. Mary's School in Hilo, Hawaii. The very hard wood is employed in the construction of boats, for posts and also charcoal.

It is a slow-growing tree, but its cultivation in Hawaii should be encouraged. It is well adapted for planting along sea beaches in sandy soil.

PAHUDIA Miquel

Calyx with elongate receptacle and four coriaceous segments, of which the two inner are larger than the outer ones. Petals one, shortly clawed, broadly-orbicular, the lower ones rudimentary or missing. Stamens 7, united into a sheath to near the apex, split above; filaments free at the apex, of unequal length; staminodia usually two, small, at the base of the sheath. Ovary stipitate, with few ovules; style filiform, with a small, terminal stigma. Pod compressed, linear, subfalcate, coriaceous. Seeds surrounded at the apex by a bright red arillus. Unarmed trees with paripinnate leaves and coriaceous leaflets. Flowers in paniculate racemes.

A genus of about three species, of which *Pahudia rhomboidea* of the Philippines is in cultivation in these islands. The trees are still small. The two other species are native of Java and the Sunda archipelago respectively.

Pahudia rhomboidea (Blanco) Prain in Sci. Mem. Med. Off. Ind. Army 12:14. 1901.
Eperua rhomboidea Blanco Fl. Filip. 2:260. 1845.

Tindalo.

A tree reaching a height of 25 m, glabrous except the inflorescence; leaves simply pinnate up to 25 cm long, leaflets usually 8, opposite, oblong-ovate to elliptic ovate, acuminate, shining, 5-8 cm long; panicles terminal and axillary, pubescent, equalling or shorter than the leaves; calyx green, pubescent; petals

yellowish-red; pod woody, thick, somewhat rhomboid, about 20 cm long, 8 to 10 cm wide, about 8-seeded; the seeds black, more than one-half enclosed by the orange-red aril.

The *Tindalo,* as the tree is known in the Philippines, is endemic to the latter islands, where it is widely distributed. It is a timber tree of great importance, the heartwood being a beautiful reddish color and very close grained. The seeds of this species germinate readily, and for the first few weeks grow rapidly, after which growth is exceedingly slow. Specimens grown from seed have been planted out at the College of Hawaii grounds, where they are making slow progress.

LYSIDICE Hance

Calyx with cylindrical receptacle, dilated toward the apex, and with four elongate-elliptical, obtuse segments, the latter reflexed at anthesis. Upper three petals subequal, obovate, long-clawed, the two lower very small, rudimentary. Fertile stamens only two, the two posterior stamens with sterile anthers, the two anterior reduced to unequal staminodia, the remaining abortive. Ovary with short stipe, the latter adhering to the receptacle, 9-12 ovuled. Style slender, with small terminal stigma. Pod long-obovate compressed, acute, coriaceous to woody, 2-valved. Seeds separated by spongy septae, flat, without albumen. Shrub or tree with paripinnate leaves; leaflets 4-6-jugal. Flowers in terminal, paniculate racemes.

A genus of a single species, *L. rhodostegia*, a native of southern China, with pink bracts, red calyx, and purplish-black corolla.

Lysidice rhodostegia Hance in Journ. of Bot. 5:298. 1867.

A small tree 7 to 8 m high; branches glabrous, cylindrical; leaves 25 to 30 cm long, the common petiole 15 to 18 cm, glabrous; leaflets 4 to 12 cm long, 25 to 50 mm wide, acuminate, abruptly mucronate at the apex, rounded or obtuse at the base; panicle about 20 cm long; bracts elliptical 10 mm long, pink and shortly puberulous; pedicels pubescent 10 to 12 mm long; bracteoles oblong, ciliolate, 3 mm long; flowers purplish; calyx tube 8 to 12 mm long, glabrous, lobes 4, 8 mm long, 3 to 4 mm wide; petals 3, long clawed, quite glabrous; fertile stamens 2, occasionally 1, very rarely 3, 20 mm long; anthers elliptical, 4 mm long; filaments of sterile stamens much shorter than the petals; pistil stipitate; ovary puberulous; style 20 mm long; pod 15 cm long, 35 to 40 mm wide, shortly apiculate.

A native of southern China, not uncommon about Canton, also in Tonkin, Cochin China. The species was introduced by the writer from the Botanic Gardens of Peradeniya, Ceylon, and specimens have been planted at the College of Hawaii grounds.

The tree is a fairly rapid grower if given a chance, and the specimens planted out are doing very well. The tree seems to be quite hardy, and on account of its handsome purplish-red flowers and pink persistent bracts is worthy of cultivation. The percentage of germination is very high, and as a whole the young seedling does not need any particular care, but is quite hardy.

PLATE 24.

BAUHINIA MONANDRA Kurz.
St. Thomas Tree.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Brownea hybrida Hort. Bot. Gard. Buitenzorg, Java.

Two seedlings were introduced under this name from the Botanic Gardens of Buitenzorg, Java, in 1916. Both were planted out at the College grounds, where they are doing nicely. Seeds were also introduced of *Brownea coccinea*, but they had lost their germinating power before reaching Hawaii. Recently the writer brought back with him from Java seeds of several species of *Brownea* as *Brownea hybrida* and *B. coccinea;* they are being grown at the Nuuanu Nursery of the H.S.P.A.

BAUHINIA Linn.

Flowers hermaphrodite, rarely polygamous. Calyx with turbinate or tubular receptacle undivided before anthesis, and closed at the apex, splitting variably at anthesis, spathaceous or with 3 or 5 valvate segments. Petals 5, subequal or equal. Stamens 10, all fertile, with free or more or less united filaments and dorsifixed anthers, often 1-9 reduced to staminodia or entirely missing. Ovary sessile, 2-many ovuled; style very short or sometimes rather long, filiform with small terminal sometimes dilated or peltate stigma. Pod usually oblong or linear, rarely broad, straight, flat, indehiscent or 2-valved, thin or coriaceous. Seeds compressed ovate with thin testa and albumen. Trees or shrubs or climbers sometimes with circinate tendrils. Leaves simple, usually deeply cleft from the apex, rarely entire or consisting of two leaflets. Flowers white, pink, red, or purple in simple terminal or also axillary racemes or panicled racemes.

The genus consists of over 150 species, and is distributed over the tropics of both hemispheres.

Quite a number of species are in cultivation in Honolulu and elsewhere in the Territory.

KEY TO THE SPECIES.

Trees or shrubs, branches not cirrhiferous (not tendril-bearing).
- Fertile stamens 10.
  - Leaflets entirely distinct, flowers white, stamens crimson .... **Bauhinia binata**
  - Leaflets connate, longer than broad.
    - Plants unarmed.
      - Flowers solitary drooping, or in axillary pairs, yellow; pods puberulous. .... **Bauhinia tomentosa**
      - Flowers in racemes, pure white, pods glabrous .... **Bauhinia acuminata**
    - Plants aculeate.
      - Flowers large white, in threes in the leaf-axils, petals linear oblong. .... **Bauhinia candicans**
- Fertile stamens 3.
  - Flowers pinkish-white, petals spreading .... **Bauhinia purpurea**
- Fertile stamens 5.
  - Flowers purplish, the lower petal variegated with red and yellow .... **Bauhinia variegata**
- Fertile stamens 1.
  - Flowers pink, the lower petal mottled .... **Bauhinia monandra**

Scandent bush or climber, branches cirrhiform, flowers small pinkish-white .... **Bauhinia corymbosa**

PLATE 25.

BAUHINIA TOMENTOSA Linn.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Bauhinia monandra Kurz. in Journ. As. Soc. Beng. 42²:73. 1873.
Bauhinia richardiana Wall in Voigt Hort. Suburb. Calcut. 255. 1845. Non DC.
Bauhinia Krugii Urban. Ber. Deutsch. Bot. Ges. 3:83. 1885.

St. Thomas Tree.

Plate 24.

A small or medium sized tree. the branches long spreading; leaves 11 to 15 cm long and wide, cleft about half way to the base, the lobes rounded or obtuse, base broadly cordate, 13-nerved; racemes few-flowered, axillary; calyx 2.5 cm long, split to the base on one side; corolla about 10 cm in diameter, the petals spreading, not at all imbricate, narrowly obovate, long-clawed, pink-purple with numerous, small, darker, dots, the upper petal much darker than the others; stamen 1, as long as the style and ovary; pod stout, thick about 20 cm long, 2.5 to 3 cm wide.

The so-called St. Thomas Tree is probably a native of tropical America, but now cultivated in many tropical countries.

It is commonly planted in Honolulu and on the other islands of this group on account of its handsome pink flowers.

Bauhinia corymbosa Roxb. Cat. Calcutta, 31. 1814.

Phanera.

A climber with terete cirrhiferous branches; leaves small cordate at the base, rufo-villous below along the nerves, petioles, also on the branches and calyx; leaflets semioval, obtuse, 3-nerved; stamens 3, petals ovate, stipitate, pinkish-white; pod 15 cm long, dark purplish-brown, flat.

This very handsome species, which is represented in Hawaii by several forms, is commonly known under the name of *Phanera*. It is a most beautiful climber and is splendidly adapted for arbors. Specimens are found in Mrs. H. Isenberg's grounds at Lihue, Kauai; Mrs. A. Gartley's residence in Nuuanu Valley, Oahu, and Dr. B. D. Bond's home in Kohala, Hawaii. Specimens were grown from seed given by Mrs. Gartley and planted at the College of Hawaii grounds. A small leaved variety of the species was grown by Dr. H. L. Lyon.

Bauhinia tomentosa Linn. Spec. Pl. 375. 1753.

Plate 25.

An erect branched shrub 1.5 to 3 m high, the branchlets, lower surfaces of the leaves and pods somewhat pubescent; leaves 4 to 7 cm long, about as wide, split about one-third to the base into two, ovate, rounded lobes; flowers pale-lemon-yellow, usually in pairs on axillary peduncles; calyx limb spathaceous, split down one side; petals about 5 cm long, 4 cm wide; stamens 10, all fertile, unequal in length, the filaments 1 to 2 cm long; pod 9 to 11 cm long, about 1.5 cm wide, flattened, acuminate, containing 6 to 10 seeds.

A native of India, especially common in the northwest Provinces and extending throughout India to China, Ceylon, and tropical Africa. The wood is tough and close-grained, but when full grown it is very soft. A durable fibre

PLATE 26.

BAUHINIA PURPUREA Linn.

is prepared from the bark by the natives of India. Not commonly cultivated in Honolulu. Odd specimens may be seen in Kapiolani Park at Waikiki, and in the vacant lot opposite the Pleasanton Hotel on the corner of Punahou Street. A handsome flowering shrub worthy of more extensive cultivation.

Bauhinia purpurea Linn. Spec. Pl. 375. 1753.
Bauhinia triandra Roxb. Hort. Beng. 31. 1814.
Bauhinia coromandeliana DC. Prodr. 2:515. 1825.

Plate 26.

A middle sized erect tree, with moderately stout glabrescent branchlets; leaves rigidly subcoriaceous, 9 to 11-nerved, glabrous, shallowly cordate, the lobes obtuse or subacute, reaching one-third to one-half way down; flowers in terminal and axillary short peduncled, few-flowered corymbs; bracts minute, deltoid; lower pedicels 6 to 12 mm: calyx tube 6 to 12 mm long, the limb 2.5 cm, coriaceous, slit into 2 valves, which show a division into five teeth; petals oblanceolate, with a long claw, reddish or pinkish-white (white with pinkish veins and margin), twice the length of the calyx; fertile stamens 3; ovary gray-downy, with a long stalk and style and moderately large oblique stigma: pod 1.5-3 dm long, up to 2.5 cm wide, firm, flat, glabrous, late in dehiscing, rather decurved, 12 to 15-seeded.

A native of India, but also found in Ceylon, Penang, Siam, and China.

The species is of recent introduction. Specimens were grown from seed imported from Java and Peradeniya by the writer and specimens have been planted out at the College of Hawaii grounds, where they have already flowered several times.

The species is worthy of cultivation. It is not deciduous, and as it is a small tree, for the most 30 feet in height, it is well suited for street planting. The flowers are of a delicate white and pink, and are exceedingly fragrant. They are about four or five inches across. Photograph from a specimen grown at the College of Hawaii.

Bauhinia variegata Linn. Spec. Pl. 375. 1753.
Bauhinia candida Roxb. Hort. Beng. 31. 1814.

A middle sized erect tree; leaves rather broader than long, 9 to 11-nerved, pubescence gray, rigidly subcoriaceous, deeply cordate, the obtuse lobes reaching one-fourth to one-third down; corymbs few-flowered, lateral, sessile or short peduncled; pedicels short; calyx tube up to 2.5 cm; the limb cordate-ovate, remaining to the end spathaceous and entire, and equalling the cylindrical tube; petals up to 5 cm long, 2.5 cm or more broad, purplish, beautifully variegated with red and yellow (sometimes pure white *Bauhinia candida* Roxb.), obovate, clawed and much exserted; stamens 5, subequal, filaments glabrous equalling the petals; anthers oblong, 7 mm long; ovary puberulous; style glabrous 5 mm long, stigma minute; pod up to 3 dm long, 15 mm wide, hard, flat, glabrous, rather decurved, dehiscent, 10 to 15-seeded.

A native of India, Siam, Burma, China, and Java. An exceedingly handsome species and certainly worthy of cultivation on account of its large, beautiful flowers.

PLATE 27.

BAUHINIA BINATA Blanco

There are quite a number of trees in Honolulu gardens. They flower in the late winter, February to March. It is well adapted for street planting where large trees are not desired. Specimens are growing at the College of Hawaii grounds. During the rainy season the trees are loaded with the large purple and variegated flowers, and are an object of great beauty. The tree is not deciduous.

Bauhinia binata Blanco Fl. Filip. 331. 1837.
Bauhinia pinnata Walp. in Linnaea 16. Litt. ber. 53. 1842.
Phanera blancoi Benth. Pl. Jungh. 264. 1852.
Bauhinia blancoi Baker in Hook. f. Fl. Brit. Ind. 2:278. 1878.

Plate 27.

A glabrous tree; leaflets 3.75 cm in diameter, quite distinct down to the petiole. rigidly subcoriaceous. finely 5 to 7-veined, deeply rounded below the point of insertion, rounded at the apex, very obtusely obovate, and oblique at the base; flowers in dense axillary corymbs: pedicels short, 6 mm; calyx tube cylindrical 6 to 11 mm long. finely velvety; sepals lanceolate, not equalling the tube: petals white. much exserted. oblong-obovate, distinctly clawed, pubescent outside. or villous especially at the base; fertile stamens 10, crimson, longer than the petals; pod 12.5 to 15 cm long, 2.5 to 3 cm broad, glabrous, 8 to 10-seeded.

This very handsome species is a native of India and the Philippines. In the latter country it is, according to Merrill, a scandant shrub.

There are very few specimens in Hawaii of this species. One is in the premises of Mrs. Hans Isenberg of Kauai. and another handsome tree in the grounds of the Normal School in Honolulu.

The species seems to be exceedingly close to the Australian species *Bauhinia Hookeri* F. v. M.; a variety of the latter is recorded as var. *puberula*. and in a footnote it is remarked (Flora of Australia. 2:296) that it may be identical with *B. blancoi,* the proper name of which, according to Merrill, is *B. binata* Blanco.

One of the handsomest species of *Bauhinia* and worthy of cultivation.

Two specimens have been planted at the College of Hawaii campus.

Bauhinia acuminata Linn. Spec. Pl. 375. 1753.

An erect shrub 2 to 4 m high, somewhat pubescent: leaves 7 to 13 cm long, 6 to 12 cm wide, base somewhat cordate, 9 to 11-nerved, the lobes acute or slightly acuminate, about one-third the length of the leaf: racemes axillary, short, few-flowered; calyx green, about 3 cm long, split down one side. acuminate, the apex with 5 short, slender teeth; corolla white, about 8 cm in diameter; stamens 10, shorter than the petals. the latter oblong. and as long as the calyx limb; pod 10 to 12.5 cm long. 18 mm wide, firm, glabrous, 8 to 12-seeded.

A native of India, China, the Malay Islands, and Ceylon.

Specimens of this species are growing at the College of Hawaii grounds, from seeds imported from the gardens of Peradeniya, Ceylon, by the writer. The plants have already flowered in Honolulu. Worthy of cultivation on account of the handsome white flowers.

PLATE 28.

CASSIA FISTULA Linn.
Golden Shower.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Bauhinia candicans Benth. in Mart. Fl. Bras. 15^2:201. 1870.

A tree 10 m high; branchlets and inflorescence tomentose; aculeate; leaves obtusely or somewhat acutely bilobed, nine-nerved, 7.5 to 10 cm long, rigid, tomentoso-pubescent below; pedicels in pairs; calyx tube cylindrical before anthesis; about 12 mm long, the spathaceous limb up to 5 cm; petals white, nearly 7.5 cm long, broadly linear-oblong, obtuse, anthers all linear; pod 15 to 20 cm long, less than 2.5 cm wide, always glabrous.

A native of Uruguay and Argentine, but probably cultivated in Brazil and other parts of South America. There is only one mature tree in Honolulu. It can be found in Mrs. Judd's premises on Wyllie Street, Nuuanu Valley. The large white flowers make this tree an object of great beauty. Seeds were introduced from Brazil and specimens are now growing at the College of Hawaii grounds.

Bauhinia aculeata Linn. Spec. Pl. 374. 1753.

Bauhinia aculeata Linn., a native of tropical America, has been introduced into these islands by the writer from the Buitenzorg Gardens, Java. Specimens are growing at the College of Hawaii grounds, but have so far not flowered.

CERATONIA Linnaeus

Calyx with five short tooth-like caducous segments. Petals wanting. Stamens episepalous, five, with filiform filaments and ovate rather thick dorsifixed, longitudinally dehiscing anthers, within the stamens a dilated, glandular disk. Ovary in the center of the disk shortly stipitate, with many ovules; style very short, with peltate stigma. Pod linear oblong, compressed, thick-coriaceous, indehiscent with both sutures thickened, septate by thick pulpy or fleshy walls. Seeds obovate, compressed, with albumen. A small or medium sized tree with dense, evergreen crown. Leaves paripinnate, with coriaceous, few-jugate leaflets. Stipules very small or missing. Flowers small, polygamous diclinic, in short, single or fasciculate racemes.

A single species, widely distributed in the eastern Mediterranean region, wild and cultivated.

A. Siliqua, the St. John's bread.

The species is cultivated on Tantalus back of Honolulu.

Ceratonio siliqua Linn. Spec. Pl. 1026. 1753.

St. John's Bread.

A dioecious tree reaching a height of 15 to 16 m; often also monoecious; leaves pinnate, dark green, coriaceous, ovate, slightly emarginate at the apex, rounded at the base, usually in three pairs; inflorescence grouped along the branches, in fasciculate racemes; flowers small, reddish; pods curved, 10 to 25 cm long, 2.5 cm broad.

PLATE 29.

CASSIA NODOSA Ham.
Pink and White Shower.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

In Hawaii the tree is planted back of Honolulu on the slopes of Tantalus, but though mature trees are in abundance, it does not produce the ripe juicy pods so well known in Europe. In order to secure fecundity in trees grown from seeds, and which have no subsequent pruning, they should be planted in groups so as to have male and female trees on the same land. The establishment of a hive of bees will prove a powerful aid in the delicate business of fertilization.

It is a slow-growing but long-lived tree, reaching on age of over one hundred years and still full of sap.

It grows well in nearly all soils, but does not thrive in hard, close soils.

It can be propagated by means of seeds, root-stocks, cuttings and grafting, though the seed method is the easiest. The tree will bear when about twelve or fifteen years old, from seed. The nonproductiveness of the Tantalus trees is in all probability due to improper fertilization, or an absence of real female trees.

CASSIA Linnaeus

Calyx with short receptacle and five segments. Petals five, imbricate, subequal, or the lower larger. Stamens 10, either all fertile and nearly as long, or the upper shorter, or the three upper very short, rudimentary or entirely missing, sometimes only five, with very short or elongate, rarely in the middle thickened or dilated filaments; anthers equal in size or the lower larger, thecal with terminal pores or dehiscing longitudinally, or with basal pores. Ovary sessile or stipitate, many-ovuled; style short or long, with terminal small, truncate stigma. Pod terete, or compressed, quadrangular or winged, membranaceous, coriaceous or woody, indehiscent or often 2-valved, uninterrupted or horizontally septate. Trees or shrubs or herbs always with paripinnate leaves. Glands sessile or stipitate either at the base of the petiole or between the lower pair of leaflets. Flowers yellow, rarely white or pink or reddish, either in terminal or axillary racemes or paniculate racemes.

The genus consists of about 380 or more species, distributed in the warmer regions of both hemispheres, with the exception of Europe. The majority of the species occur in America. In Africa they are widely distributed, with the exception of the Mediterranean regions.

The genus is absent from Tasmania and New Zealand. Hawaii possesses a single native species, *C. Gaudichaudii*, with greenish yellow flowers. All other species found are either escaped from cultivation or are foreign trees; some of the species are weeds.

KEY TO THE SPECIES.

Trees or shrubs.
- Three stamens with long filaments, 7 stamens with short filaments, anthers of three basifixed opening in longitudinal slits, anthers of seven dorsifixed opening in basilar pores.
  - Flowers yellow, in elongated pendant racemes, leaflets large, pointed .... **Cassia fistula**
  - Flowers of whitish-pink or pinkish-red.
    - Anthers glabrous, flowers in short corymbs, bracts large persistent, pods terete smooth .... **Cassia nodosa**
    - Anthers hairy, flowers in solitary racemes, bracts deciduous, pods large, somewhat compressed, venately rugose .... **Cassia grandis**

PLATE 30.

CASSIA SIAMEA Lam.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Anthers opening in apical pores.
Stamens 10, all fertile, subequal or 8 smaller and 2 larger.
Peduncles subumbellately or racemosely many-flowered.
Leaflets 8 to 9 pairs, racemes terminal, flowers bright yellow, pod flat, 10-12 seeded .... **Cassia glauca**
Leaflets 3-5 pairs, racemes axillary, flowers greenish-yellow, pod flat, 8-10 seeded, seed flat, black .... **Cassia gaudichaudii**
Peduncle 2 to 4-flowered, pods and plant villous-tomentose .... **Cassia tomentosa**
Stamens 10, 7 fertile, the 3 upper reduced to staminodia.
Leaves with glands on the common rhachis.
Gland near the base of petiole, leaflets 3-6 pairs, pods flattened .... **Cassia occidentalis**
Gland between the lowest pair or two lowest pair of leaflets.
Leaflets large ovate acute, legume terete .... **Cassia laevigata**
Leaflets small, obovate or oval, rounded at the apex, pod slightly curved, subterete, bicapsular .... **Cassia bicapsularis**
Leaves without glands, the rhachis channeled above.
Shrubs; flowers in subspicate racemes or racemes.
Pods winged along the valves, leaflets large, 15 cm long .... **Cassia alata**
Pods not winged, leaflets 2.5 to 5 cm long ... **Cassia didymobotrya**
A tree; flowers yellow, small, in corymbose panicles, leaflets not exceeding 6 cm, pods up to 30 cm long, thickened along the sutures .... **Cassia siamea**
Herbs or undershrubs.
Leaflets multi-jugate, very small.
Gland stipitate, leaves 10 cm long, pedicels 3 cm long ..... **Cassia glandulosa**
Gland depressed sessile, leaves 6 cm, pedicels less than 1 cm .... **Cassia mimosoides**

Cassia fistula Linn. Spec. Plant. *377.* 1753.

Golden Shower, Indian Laburnum.

Plate 28.

A middle-sized, at times a large tree; leaflets glabrous when full grown, 4-8 pairs, ovate acute; flowers yellow, large, in lax, long, pendulous racemes, pedicels slender; pod cylindrical, up to 1 m in length; seeds embedded in black, sweet pulp.

The Golden Shower is a native of India, Burma, and Ceylon, where it occurs in the deciduous forests; it ascends to 4000 feet in the Himalayas. The flowers, which are very showy, are used in temple ceremonies in Ceylon. It is suitable to rather dry regions, but thrives also in moist districts. The root, bark, and the pulp of the pod are employed medicinally as a simple purgative. The bark is also used in tanning, and a red dye is also extracted from it.

An artificial hybrid has been produced by crossing the Golden Shower and Pink and White Shower (*Cassia fistula* × *Cassia nodosa*). There are only a few trees extant in Honolulu which flower profusely. The flowers are much handsomer than in either species, but consist of petals only; no vestige of ovary or stamen is visible. Consequently it produces no seeds. It can only be reproduced by again crossing the two species. Occasionally a natural hybrid will occur. The young plants are recognizable by the much larger and pointed leaflets.

The wood of the Golden Shower is very hard and heavy; sapwood large; heartwood varying in color from gray to brick-red, and darkens on exposure.

PLATE 31.

CASSIA GLAUCA Lam.

It is durable but brittle, difficult to work, and is apt to splinter. In Java it is said to last longer in the ground than teak and to be not attacked by insects. It is employed for posts, carts, agricultural implements, bows and boat-spars, also as bed-plates for machinery.

Cassia nodosa Ham. ex Roxb.,Hort. Beng. 31. 1814.

The Pink and White Shower.

Plate 29.

A middle-sized or large evergreen tree, the youngest shoots silky, leaflets 6 to 12 pairs, thinly coriaceous, glabrous and glossy above, opaque beneath, elliptic-oblong, acuminate, or rounded and retuse; flowers pink and white, arranged in short racemes from the old branches, bracts ovate lanceolate, persistent, pedicels twice as long as the flower; pod terete, black, nearly half a meter long, seeds horizontally arranged.

According to Mr. Merrill, *Cassia nodosa* is a synonym of *Cassia javanica*. There is no doubt in the writer's mind that such is the case, but in absence of actual material of the two supposed species he is not in a position to decide the question here. There seems to be no difference in the dscription of the two species. In *Cassia javanica* the leaflets are acuminate to acute, while in the Hawaiian grown *Cassia nodosa* the leaflets are rounded and retuse; Merrill, however, states that leaflets of both types are common.

The specific name *javanica* being the older, should be adopted, but as the question in regard to specific distinction is still an open question, the specific name *nodosa*, by which the tree is known in Honolulu, is here adhered to.

The wood of the Pink Shower is moderately hard and heavy; the sapwood is light brown, the heartwood red. It is not a very useful wood.

Cassia grandis Linn. f. Suppl. 230. 1782.
Cassia brasiliana Lam. Dict. 1:649. 1783.
Cassia mollis Vahl. Symb. Bot. 3:57. 1794.

Pink Shower.

A rather large or medium-sized tree; leaflets in 10-20 pairs, oblong, rounded at both ends, pubescent underneath, puberulous above; petiole without glands; infloresence axillary raceme drooping, with a rusty pubescence, flowers pink, pedicels without bracts, anthers hairy; pod compressed cylindrical, transversely rugulose, and glabrous, up to 1 meter in length. (1.5-3 feet.)

The Pink Shower is a native of South America, but occurs also in the islands of the Caribbean Sea. On account of its beautiful flowers it is cultivated more or less in all tropical countries. It flowers during the months of February and March. It was introduced in all probability by the Royal Hawaiian Agricultural Society, as Dr. Hillebrand mentions it in his Flora. See also Rock, The Ornamental Trees of Hawaii.

PLATE 32.

CASSIA ALATA Linn.

Cassia siamea Lam. Encycl. 1:648. 1785.
Cassia florida Vahl Symb. 3:57. 1794.

Plate 30.

Kassod Tree.

A middle-sized or sometimes a large tree, bark gray, nearly smooth. leaflets 6 to 10 pairs, papery, elliptic-oblong, tipped with minute sharp mucro, glabrous on both sides, racemes often corymbose, arranged in a large pyramidal terminal panicle. often two-thirds of a meter (2 feet) long, bracts stiff. linear, shorter than the pedicels; flowers yellow, petals 12 mm long; pod flat. 10-25 cm or more long. 1 cm wide, and velvety, the sutures thickened: seeds 10-20.

Cassia siamea is probably a native of Burma and is cultivated throughout India and many tropical countries. In Honolulu it is quite commonly met with, but is not cultivated so frequently as the other more showy *Cassia* - as *Cassia nodosa*, *C. grandis*, and *Cassia fistula*.

In Burma the wood is used for mallets and walking-sticks. In Ceylon it is used as a fuel. The wood is hard and heavy and quite durable: the sapwood is whitish and rather large, the heartwood is dark brown to nearly black in stripes of dark and light. It is employed for building. helves. and for the purposes mentioned above.

Cassia glauca Lam. Encyc.. 1:647. 1785.
Cassia suffruticosa Wall. Cat. 5311. 1832.
Cassia speciosa Roxb. Hort. Beng. 31. 1814.

Plate 31.

A shrub or small tree with glabrous terete branches; leaves distinctly petioled: leaflets 16 to 18, obtuse, 2.5 to 5 cm, ovate, subcoriaceous, quite glaucous. rhachis with conspicuous glands between the lower leaves; stipules narrow, caducous: raceme corymbose, not panicled: sepals obtuse; flowers bright yellow: all 10 stamens perfect, anthers subequal. pods 7.5 to 10 cm long. flat, thin. strap-shaped. glabrous, 10 to 12-seeded. distinctly stalked.

A native of India and Ceylon. also distributed to the Malay Isles, tropical Australia, and Polynesia.

A very common plant in Honolulu, usually planted along fences in Manoa Valley, also as isolated individuals in gardens. A number of specimens can be seen in the vacant park-like lot on Punahou Street opposite the former Pleasanton Hotel.

The plant flowers all the year round, is quite hardy, and useful as a hedge plant.

Cassia tomentosa Lam. Dict. 1:647. 1785.

This species was introduced by the writer from Southern California, where he collected the seeds. It is a handsome shrub. with deep golden yellow flowers. It is able to stand a cold temperature, as well as drought. On account of its ornamental value, the plant should be cultivated. Plants have been set out at the College of Hawaii grounds.

PLATE 33.

CASSIA DIDYMOBOTRYA Fres.

Cassia alata Linn. Spec. Plant. 378. 1753.

Plate 32.

A coarse erect branched shrub 1.5 to 3 m high, the branches stout, green; leaves equally pinnate, 40 to 60 cm long; leaflets 16 to 28, oblong, apex broad, rounded, apiculate, 5 to 15 cm long, gradually increasing in size upwards; inflorescence of terminal and axillary, simple or panicled spike-like, peduncled racemes, 10 to 50 cm long; flowers yellow, about 4 cm in diameter, the buds subtended by thin, yellow, oblong, concave bracts, 2.5 to 3 cm long, which are imbricate and conceal the buds, falling as the flowers open; upper 3 stamens reduced to staminodia, the lower two with large anthers, the lateral pairs small; pods straight, spreading, about 15 cm long, 1.5 cm wide, valves with a crenulated, chartaceous wing running from end to end; seeds 50 to 60, flattened triangular.

Cassia alata is a native of tropical America, but is now cultivated all over the tropics.

In Honolulu it has been only lately in cultivation, but numerous specimens can be seen now in Nuuanu and Manoa Valleys, as well as elsewhere in private gardens.

The species is depuratory, purgative, and antiherpetic. The seeds are vermifugal. The active principle is Chrysophanic acid. The juice of the leaves mixed with lemon juice is a very good remedy for diseases of the skin. In fact every portion of the plant is regarded as being an excellent antidote for snake-poison.

Cassia didymobotrya Fresen. in Flora. 22:53. 1839.

Plate 33.

A shrub or small tree 2.5 to 3 m high; branches and leaves at first puberulous; leaves 12.5-25 cm or often 35 cm long; rhachis pubescent, plane or slightly convex above; eglandular or with rudimentary gland between some of the leaflets; leaflets in 8 to 16 pairs, oval-oblong or oblanceolate-oblong, rounded at the apex, with a conspicuous slender mucro, obliquely rounded at the base, 2.5 to 5 cm long, 10 to 18 mm wide, subsessile; stipules ovate-rotundate, apiculate, reflexed, deciduous, less than 12 mm long; racemes simple, erect, 15 to 30 cm long from the axils of the uppermost leaves, solitary or two or three or more collected about the ends of the branches, equalling or exceeding the leaves; flowers at first closely packed with elliptical or ovate imbricating caducous bracts 12 mm long; petals bright (but pale) yellow, obtuse, very shortly clawed; two of the anterior anthers much enlarged, curved, 10 to 12 mm long; legume two-valved, flat, linear-oblong, 7.5 to 10 cm long, 16 mm broad; valves thinly coriaceous, transversely depressed between the (9 to 16) seeds when dry. Seeds horizontal, obovate oblong, with a narrow linear areole on each face, compressed.

Cassia didymobotrya, a native of tropical and subtropical Africa, where it occurs in the Nile land, lower Guinea, and Mozambique, has been introduced by the writer from Egypt two years ago. Plants were grown from seed. These have reached now a height of 10 feet, have flowered and seeded, and a second generation has been started at the H.S.P.A. Nuuanu Nursery. It is a handsome species, on account of its showy flowers, which are of a lighter yellow than those of *C. alata*, which it resembles in habit.

The leaves and plant when bruised emit a rather unpleasant odor.

PLATE 34.

CASSIA LAEVIGATA Willd.

Cassia laevigata Willd. Enum. Hort. Berol. 441. 1813.

Plate 34.

An erect glabrous shrub about 2 m high; leaflets 3 or 4 pairs, ovate to lanceolate, usually acuminate 3.75 to 7.5 cm long, with an oblong or slender gland between those of each pair; racemes axillary or also terminal, pedunculate, short and almost corymbose, the upper ones forming a short terminal panicle; sepals unequal, the inner ones 8 to 10 mm long; petals broad, yellow, very obtuse, varying from 12 to 18 mm; perfect anthers 4, almost sessile, 1 on short and 2 on much longer filaments; pod 5 to 7.5 cm long, membranous or slightly coriaceous, cylindrical or more or less inflated when ripe, opening at length in 2 valves; seeds crowded and horizontal.

A native of tropical America, but now widely distributed in the tropics, even in tropical Africa.

This species, while common in waste places on Oahu and the other islands, is less common than *Cassia bicapsularis* Linn., with which it is often confused.

Cassia bicapsularis Linn. Spec. Pl. 376. 1753.

Plate 35.

A shrub with virgate woody branches, glabrous; leaves distinctly petioled; leaflets 6 to 8, green, membranous, obovate, obtuse, 12 to 18 mm long; stipules small, subulate, caducous; racemes copious, corymbose as long as the leaves; flowers middle sized, bright yellow; stamens very unequal, 7 perfect, 3 posterior filaments without anthers; pod terete, thick, membranous, curved, sausage-shaped, 15 cm long, 1.75 cm thick, the sutures very narrow, seeds biseriate.

A native of tropical America, but now widely distributed over the tropics. It is one of the most commonly-met Cassias in Honolulu, or rather Oahu. It is a scandent shrub and may be found in all the valleys back of Honolulu, climbing over fences, rock walls, etc. It is by far more common than *Cassia laevigata* Willd., with which it has been confused by nearly all Hawaiian botanists. This is the first time that the plant is recorded from these islands.

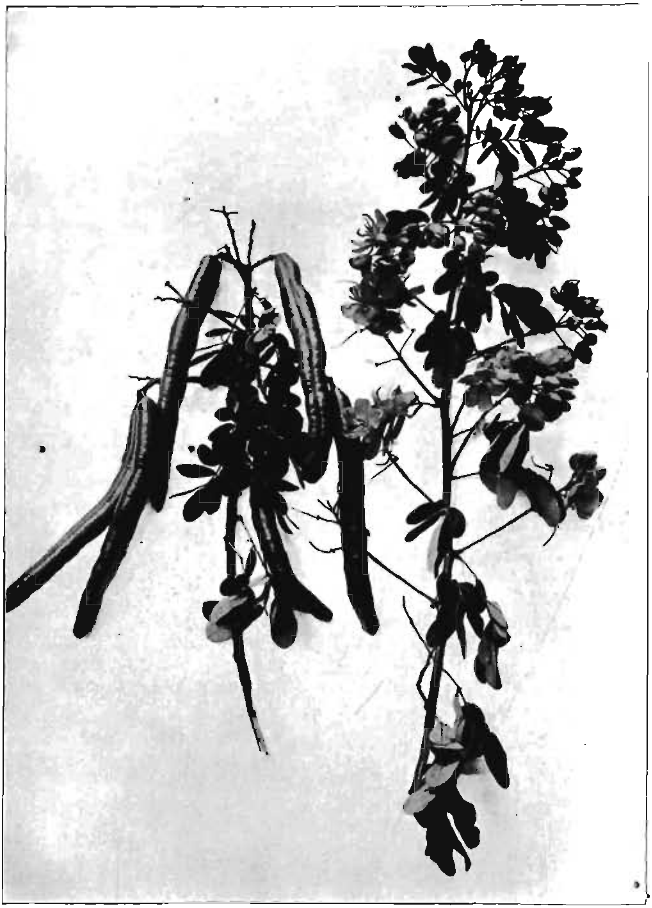
The species is easily distinguished by the much smaller leaves, which are not pointed, the shorter racemes, and smaller flowers and biseriate seeds. *Cassia laevigata* is an erect shrub, while *Cassia bicapsularis* is a scandent shrub with rambling branches.

Cassia Gaudichaudii Hook. et Arn. Beech. Voy. 81. 1841.

Kalamona.

A low shrub 1 to 1.5 m high, with spreading branches, the young shoots fulvo-tomentose; leaves 7.5 to 10 cm long, with 4 to 5 pairs of leaflets, the rhachis pubescent, with a stipitate or clavate gland between the lowest pair; the leaflets 2.5 to 6.25 cm long, 1.25 to 2.5 cm broad, elliptical-oblong, retuse, membranous, on petioles of 2 mm; stipules subulate 10 to 12 mm; racemes axillary, slender 5 to 7.5 cm long, naked in the lower half; pedicels 18 to 24 mm, pubescent, articulate a short distance below the calyx; bracts lanceolate, 3 mm; sepals pubescent 8 to 10 mm long, obtuse; petals pale yellow or greenish, scarcely longer than the sepals; stamens 10, all fertile, the oblong anthers opening by short slits,

PLATE 35.



CASSIA BICAPSULARIS Linn.

he short filaments glabrous; ovary stipitate, hairy; pod linear-oblong, 6.25 to 12 m long, 8 to 10 mm broad, quite flat, apiculate at the middle of the apex, impressed between the seeds, 2-valved, with thin valves, septate internally; seeds 5 to 10, oblong, flat, black, transverse and parallel with the valves.

A native of these islands, but also occurring in Tahiti. It inhabits the dry and semi-arid region of all the islands of this group. It is not uncommon on the vest end of Molokai, on the plains with *Sida*, *Argemone*, *Euphorbia*, etc. At Puuwaawaa, North Kona, and Huehue of the same district on Hawaii, it occurs on the aa (rough) lava flows. In that locality it is covered with a soft greenish-yellow pubescence, while plants occurring on the Island of Lanai, back of the old Gibson homestead in the valleys, are quite glabrous and larger in every respect; the flowers have a slight pinkish tinge in the Lanai specimen; otherwise the same. In Tahiti it occurs on the precipices of the valley of Papaeva and Punaruu, and is not known outside of Tahiti and Hawaii.

Cassia occidentalis Linn Spec. Plant. 377. 1753.

Plate 36.

An erect, somewhat branched, glabrous, suffrutescent herb or shrubby plant 0.8 to 1.5 m high; leaves pinnate, about 20 cm long, the rhachis with a large gland at the base; leaflets rank-smelling, 5 pairs, oblong lanceolate, acuminate, 4 to 9 cm long; racemes few-flowered, axillary and terminal, corymbose; flowers yellow, 2 cm long; bracts thin, ovate-acuminate, caducous; pedicels spreading 12 to 18 mm; sepals obtuse, glabrous; perfect stamens 7, the anthers subequal, 3 posterior filaments without anthers; pod about 10 cm long, 9 mm wide, thickened, slightly falcate, containing about 40 seeds.

A native of tropical America, but now found in most tropical countries. It is a very common weed in Honolulu, and in fact on all the islands. On the windward side of Oahu it is very common in pasture lands, and it is there that it reaches its best development; plants more than 6 feet in height have been observed. It is dangerous to live stock when eaten fresh.

The various portions of this plant are purgative, and the roasted seeds are used for malaria. In Reunion it is employed for stomach troubles and asthma. The root is tonic and diuretic, while the leaves are employed as a febrifuge and anti-periodic. In Australia the plant is looked upon with suspicion, and in Hawaii the writer is quite certain that it has caused the death of live stock, especially on the windward side of Oahu, where the plant grows very prolific. Cattle have died suddenly in certain pastures, where there were almost pure stands of this species, which was found stripped of everything, leaves and flowers.

Cassia glandulosa Linn. Syst. Nat. ed. 10:1017. 1759.

Plant shrubby, 1-1.5 m high, leaflets oblong linear, membranous, mucronulate, slightly oblique at the base; petioles bearing a stipitate gland, below the lowest pair; peduncles 1 to 3, 1-flowered, twice as long as the flowers, much exceeded by the leaves; stamens 10, filaments very short; flowers yellow; pod bearing scattered, whitish curved hair; the seeds small quadrate.

PLATE 36.

CASSIA OCCIDENTALIS Linn.

Our plant is here referred to the West Indian *Cassia glandulosa;* Griesebach states that it is a very variable species. The plant in question is cultivated at the Hawaiian Sugar Planters' Experiment Station under the name *Cassia mimosoides.* It is, however, not identical with that species, as it differs from it in the stipitate gland, the longer, filiform peduncles and subequal stamens; the median nerve is also much less eccentric than in *C. mimosoides.* It is a native of the West Indian Islands, and ranges from Cuba to Brazil.

Cassia mimosoides Linn. Spec. Plant. 1:379. 1753.

Plate 37.

An annual herb, suberect, slightly branched, glabrous or slightly pubescent; leaflets 15 to 30 pairs, linear oblong, oblique or cultrate, mucronate-acute, rigidly membranous, the midrib nearer the upper margin, 8-16 mm long, glabrous or almost hairy, gland below the lowest pair of leaflets, sessile and depressed; stipules semi-lanceolate, decidedly acute, striate; flowers small or medium-sized, several fascicled in the axils of the leaves, with very short pedicels; sepals very acute, stamens 10, or rarely less, anthers of unequal size; pod varying in size from 2.5-7.5 cm, 4 mm in width, somewhat pubescent or glabrous.

Cassia mimosoides, which was hitherto confused with *Cassia chamaecrista* in Honolulu, is one of the most common weeds in the islands. It was probably introduced in the very early days. The Japanese employ it as a tea. It is a native of South America, but now a cosmopolitan weed throughout the tropics.

In India it grows in the Himalayas, where it ascends to an elevation of 5000-6000 feet. It extends over the hills of Bengal to Khasia and to Ceylon and Malacca.

In India the root is given for spasms in the stomach. Heller in his "Plants of the Hawaiian Islands," has collected the species, but says: "Determined as *Cassia chamaecrista* by Mr. C. L. Pollard." He also remarks: "It must have been introduced since 1870, as Hillebrand makes no mention of its occurrence on any of the islands." The plant was misidentified by Mr. Pollard: *Cassia chamaecrista* has as yet not made its appearance in the islands; it was in consequence not mentioned by Hillebrand, who, however, did record our plant in question under its proper name, *Cassia mimosoides.*

SCHIZOLOBIUM Vogel

Calyx with 5 rather equal, imbricate segments. Petals 5, subequal, clawed, imbricate. Stamens 10, free, slightly deflexed. Ovary subsessile, laterally adhering to the receptacle, many-ovuled; style filiform with small terminal stigma. Pod obliquely-obovate, compressed, with 1 seed, 2-valved, the thin coriaceous exocarp separating from the membranaceous endocarp. Seeds oblong, enclosed wing-like by the endocarp at the apex; large, compressed, with albumen. Tall trees with large bipinnate leaves; leaflets small, numerous. Flowers in axillary or terminal paniculate racemes.

A genus of four species. *S. excelsum* Vogel, the *Bacurubu* of Brazil. One species is not well known, and is a native of Panama.

PLATE 37.

CASSIA MIMOSOIDES Linn.

S. excelsum was introduced by the writer from Buitenzorg, Java. Two seedlings were brought by him, besides seeds for planting.

Recently (1917) two species were described, one from Panama (*S. colvillenum*) and one from Guatemala (*S. Kellermanii*), by H. Trittier.

Schizolobium excelsum Vogel in Linn. 9:399. 1837.
Cassia Parahyba Vell. Flum. 168. Ic. 4 t. 71. 1825.
Caesalpinia Parahyba Allem. in Trab. Soc. Velloz. 56. 1851.

A tall tree 40 m tall, unarmed, branchlets, petioles and inflorescence puberulous, soon glabrate; leaves 1.3 to 1.65 m long, with 15 to 20 pairs of pinnae; leaflets 10 to 20, rarely 25 pairs, oblong, obtuse, rounded at the base, 1.25 to 2.5 cm long, glabrous, the veins inconspicuous, with appressed hair beneath; racemes up to 3 dm long, disposed in large, ample, terminal panicles; pedicels 1.25 cm long; calyx lobes reflexed at anthesis, 6 to 8 mm long; petals 14 to 18 mm long, obovate, the pubescent claw up to 4 mm long; stamens shorter than the petals; the filaments scabro-villous at the base; anthers ovoid-oblong; ovary hirsute with reddish hair; pod rounded at the apex, gradually narrowing at the base into a short, thick stalk, 10 to 12.5 cm long, about 5 cm wide above the middle, glabrous, pericarp subligneous, endocarp membranaceous; seeds 2.5 cm long, 12 to 14 mm broad, compressed, pale, shining.

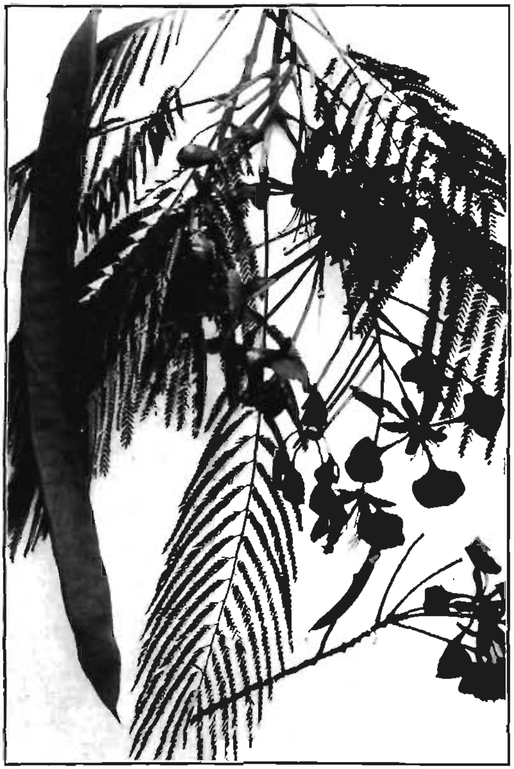
The young branches of this species are quite glutinous and are of a vivid green.

The glutinous form was described as a distinct species, "*Schizolobium glutinosum* Tul. in Arch. Mus. Paris 4:157. 1846," but was reduced by Bentham in the Flora Brasiliensis to *Schizolobium excelsum*.

It is a native of Brazil, where it occurs in the Province of Rio de Janeiro. It is a magnificent tree, reaching a height of 120 feet. Its large panicles of beautiful yellow flowers make this tree very conspicuous. Two young trees were brought by the writer from the gardens of Buitenzorg, Java; one was planted at the College of Hawaii grounds, the other at Mrs. F. J. Lowrey's place at Niniko, Nuuanu Valley. Later seeds were introduced by the writer from Java, and quite a number of seedlings were grown; a few have been planted at the College of Hawaii grounds, and the others were turned over to the H.S.P.A. for distribution. A wonderful tree, worthy of extensive cultivation. Seeds of this species should be introduced in large quantities, as it is a promising forest tree for our lowland forests.

Hillebrand reports in his Flora of Hawaiian Islands that *Cassia Parahyba* is cultivated in Honolulu, but as far as ascertained no specimens are extant today save those recently introduced. Mrs. Hans Isenberg of Lihue, Kauai, has a tree of this species in her garden; I believe it is six years old, and when the writer saw it about a year ago the tree was about 40 feet in height; it had flowered for the first time in 1918.

PLATE 38.



DELONIX REGIA (Boj.) Raf.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

PARKINSONIA Linnaeus

Calyx with short receptacle and 5 rather equal membranaceous segments. Petals 5, the *upper broader than the remaining.* Stamens 10, the filaments fimbriate at the base. Ovary free at the base of the receptacle, shortly stipitate, many-ovuled. Style filiform with small terminal stigma. Pod linear, inflated, indehiscent or weakly 2-valved. Valves thin coriaceous. Seeds oblong, vertical, with albumen. Trees or shrubs with thorny stipules. Leaves bipinnate, with very short petiole *terminating into a thorn*; pinnae 2-4, very long, with compressed rhachis and numerous, very small leaflets. Flowers yellow, in loose, axillary racemes.

Parkinsonia possesses four species; one occurs in Africa (Cape Colony), two in America, and one, *P. aculeata* L. is of wide distribution in the tropics of the old and new worlds.

Parkinsonia aculeata Linn. Spec. Pl. 375. 1753.

A glabrous bush or small tree, armed with sharp woody spines, which represent the primary rhachis of a bipinnate leaf; pinnae 2 to 6, congested in the axils of the spines; common petiole only 1 to 2 mm long; pinnae 15 to 30 cm long, the rhachis much flattened; leaflets minute, oblong or obovate, 8 to 10 mm long, 2 to 4 mm wide, blunt, the uppermost (or many) abortive; *racemes lax shorter than the leaves*; pedicels long, slender; calyx 7 mm high; corolla yellow, suborbicular, 1 cm in diameter; pod 8 to 9 cm long, 1 cm wide, constricted between the seeds.

A native of the West Indies and South America, but now more or less widely distributed in the tropics.

In Hawaii the plant made its first appearance on Quarantine and Sand Islands, where it was planted by the army authorities, but later destroyed by burning at the request of the Board of Agriculture authorities, on account of its becoming an undesirable plant similar to the Klu. Undoubtedly single plants may be, however, still found, as the plants had already seeded and seeds had been naturally dispersed by the existing plants. The species should be eradicated whenever encountered anywhere in the Territory.

It is said that the fibre of this plant is used in the manufacture of paper.

From the bark and leaves a medicament is manufactured which is used in all wasting diseases; the flowers and seeds are also used, but for intermittent fever.

HAEMATOXYLON Linnaeus

Calyx with short receptacle, and 5 rather equal strongly imbricate segments. Petals 5, oblong, subequal, imbricate. Stamens 10, free, suberect, filaments slightly hairy at the base. Ovary shortly stipitate, free, 2-3 ovuled; style filiform with small terminal stigma. Pod lanceolate, flat-compressed, membranaceous, not dehiscing at the sutures. Seeds oblong, without albumen. A glabrous tree with paripinnate or bipinnate leaves (in the lowest pair develop lateral pinnae); leaflets obovate, few. Stipules usually thorny, or small and caducous. Flowers small, yellow, in axillary, short, loose racemes.

PLATE 39.

CAESALPINIA CORIARIA Willd.
Divi-divi.

[*From J. F. Rock:* "The Ornamental Trees of Hawaii" (Copyrighted).]

A genus of a single species, *H. campechianum* Linn. The Blood-wood tree or Log-wood tree, a native of Mexico and Central America.

Haematoxylum campechianum Linn. Spec. Plant. 384. 1753.

Logwood or *Campeachy-wood.*

A much-branched tree 5-7 m high, with a smooth bark; leaves abruptly pinnate, with 3 to 4 pairs of small obovate obtuse or retuse, rigid-veined leaflets, glabrous, 1.5 to 2.5 cm long; flowers yellow, fragrant, in copious, dense axillary racemes; calyx with a short receptacle and 5 subequal ligulate lobes; petals 5, small, equal oblanceolate; stamens 10, free, with filaments hairy at the base; pod flat, thin, membranous, subsessile, narrowed to both ends, splitting not by the sutures but the middle of the valves.

Hematoxylon campechianum derives its specific name from Campeachy Bay, Mexico. Originally a native of Mexico, it also has found its way into South America, Jamaica, and the West Indies, but nowadays it may be found practically throughout the tropics. In Hawaii only a very few specimens can be found; one is known to the writer on Wilder Avenue and another occurs on the Government Nursery grounds on King Street.

The species, known commonly as Campeachy-wood, is valuable for its coloring matter, known as haematin or haematoxylin, $C_{16}H_{14}O_6$. This coloring matter is contained only in the heartwood, but not in the bark and sapwood, which are of no value. The wood when freshly cut is of a reddish-yellow color, which turns to blackish-red when coming in contact with the atmosphere. Logwood is still one of the natural products which have survived artificial coloring matters. Haematin is contained in the wood partly in a free state and partly as a glucoside; the latter is decomposed in cutting the wood in such a way which will allow spontaneous fermentation.

The wood is also astringent and antiseptic; the flowers are employed against chest troubles, the active principle being haematoxylin. The sapwood is white, while the heartwood is hard, heavy, close-grained, and of a reddish-brown color. It is employed for cabinet-making.

COLVILLEA Boj.

Calyx with short, ventricose receptacle, with 5, rarely only 4, thick, coriaceous, united segments. Petals 5, imbricate, the upper one very broad, the lateral ones smaller, obovate, the lower ones narrow. Stamens 10, free, deflexed, with rather thick filaments which are hairy at the base, and large anthers. Ovary subsessile, free, many-ovuled. Style filiform. Pod straight, inflated, 2-valved. An unarmed tree with bipinnate leaves; leaflets numerous, small. Stipules small, caducous. Flowers beautiful scarlet, in dense, elongate, somewhat paniculate racemes. Bracts membranaceous, colored, soon caducous.

A genus of a single species, *C. racemosa* Boj., a native of Madagascar. This handsome tree was introduced by the writer from the Botanic Gardens of Peradeniya, Ceylon.

PLATE 40.

CAESALPINIA. SAPPAN Linn.

Colvillea racemosa Boj. ex Hook. Bot. Mag. tt. 3325, 3326. 1834.

This exceedingly handsome tree was introduced by the writer from Peradeniya, Ceylon, in 1918. Seedlings were grown from seeds imported from the gardens of Ceylon. Several specimens have been planted out on the College grounds and the remainder were distributed by the H.S.P.A. It is a native of Madagascar and is worthy of cultivation on account of its beautiful racemes of scarlet flowers.

The young plants develop a very stout, thick trunk.

DELONIX Rafinesque.

Calyx tube disk-like or shortly turbinate, with 5 subequal, valvate segments. Petals 5, subequal, spreading, orbicular, or the upper differing from the rest. Stamens 10, free, declinate, filaments incurved towards the apex, villous at the base. Ovary sessile, free, many-ovuled; style filiform, somewhat club-shaped, thickened at the apex with truncate stigma. Pod large, elongated, woody, compressed, 2-valved, many-seeded. Unarmed trees with twice pinnate leaves; leaflets small, numerous. Stipules indistinct. Flowers large, showy, orange or scarlet, at the ends of the branches in racemes forming leafy panicles.

A genus of three species in tropical Africa and Asia.

One introduced species, *Delonix regia* (Boj) Raf., the "Royal poinciana," in Hawaii.

Delonix regia (Boj.) Raf. Fl. Tellur. 2:92. 1836.
Poinciana regia Boj. ex Hook. Bot. Mag. 56: t. 2884. 1829.

Royal Poinciana.

Plate 38.

A tree 15 to 20 meters high; leaves 20 to 40 cm long; pinnae 8 to 20-jugate, multi-foliolate; leaflets oblong, 7 mm long, 3 mm wide, blunt at each extremity, upon very short petioles; flowers scarlet; calyx 2.5 cm long; petals 5.5 cm long, the claw 2 cm long, the lamina orbicular, 3.5 cm in diameter; vexillum white with a pinkish tint and vari-colored; pod 12 to 37 cm long, 3 to 4.5 cm wide, woody.

This handsome tree, commonly known as *Poinciana regia*, is a native of Madagascar, but now widely cultivated throughout the tropical world on account of its gorgeous flowers. It is commonly planted in Hawaii and may be found in nearly every residential ground in Honolulu and Hilo. It flowers during the summer months, beginning the latter part of May, and continues flowering until the fall. During the winter months the tree is deciduous. It has a very strong root-system, and not even the severest storms these islands experienced in December, 1918, uprooted a single tree of this species.

The wood of this species is yellowish-white, light, soft, and loose-grained.

PLATE 41.

CAESALPINIA CRISTA Linn.
Kakalaioa.

CAESALPINIA Linnaeus

Calyx with short or very short receptacle and 5 imbricate segments, the lower concave or keel-shaped and usually larger than the rest. Petals 5, orbicular, sometimes oblong, strongly imbricate, subequal or the upper one smaller. Stamens 10, free, declinate; filaments glandular or villous at the base. Ovary sessile, free, many-ovuled; style terete often filiform, sometimes club-shaped at the apex, with terminal, truncate, or concave stigma. Pod ovoid, oblong, lanceolate or falcate, compressed or inflated, smooth or spiny, coriaceous, either 2-valved or indehiscent. Seed ovoid to globose, without albumen. Trees or tall climbing shrubs unarmed or armed. Leaves twice pinnate: leaflets small or large, numerous, membranaceous or coriaceous. Stipules variable. Flowers yellow or red, often very showy, in loose axillary or terminal paniculate racemes.

A genus of about 40 species, distributed in the warmer regions of both hemispheres. About six species occur in Hawaii, of which two are wild; one is a native.

KEY TO THE SPECIES.

Pods armed with abundant wiry prickles; scandent shrubs.
- Leaves with large foliaceous stipules, leaflets mostly less than 2.5 cm in length . . . . **C. crista**
- Leaves without stipules, leaflets 3 to 5 cm long . . . . **C. jayabo**

Pods unarmed.
- Pods 5 to 9 cm long, flat.
  - Petals distinctly clawed, stamens long exserted, pods about 2 cm wide . . . . **C. pulcherrima**
  - Petals not or but slightly clawed, stamens short or but slightly exserted.
    - An erect tree, stipules none, pods 3 to 4 cm wide, with a stout spreading beak at the upper angle of the obtuse, spreading apex . . . . **C. sappan**
    - A scandent spiny shrub, pods oblong or linear-oblong, less than 3 cm in width; stipules present deciduous . . . . **C. sepiaria**
- Pods 2 cm long, 1 cm wide, deeply concave on the inner side . . . . **C. coriaria**

Caesalpinia coriaria Willd. Sp. Pl. 2:532. 1799.

Divi-divi.

Plate 39.

A tree 6 to 10 m high, unarmed, with the petioles puberulous but otherwise glabrous; pinnae abruptly pinnate, 15-9; leaflets 16-24-jugal, oblong linear, blunt, dotted with a series of black dots beneath; flowers white, in contracted, compound racemes, branches few flowered, pedicels jointed at the base and at the top, destitute of bracts; petals as long as the calyx, 4 mm long, spathulate; legume small, 8-6 seeded, laterally incurved, flatly compressed, slightly convex on the out, concave on the inner side, wingless and sessile.

The American Dividivi is a small tree, native of South America and the West Indies, where it occurs in marshy situations. It has been introduced into many tropical countries, India and also into Hawaii. The writer is acquainted with this species from two specimens, one of which occurs on Oahu in the Government Nursery grounds, the other on Hawaii, where it grows in the lot facing the county building or court house of Hilo.

The pods of this species have taken an important place amongst tanning

PLATE 42.

CAESALPINIA JAYABO Maza
Kakalaioa.

materials. It has been in cultivation in India since 1830, where it has become thoroughly acclimated. It can be cultivated in drier climates and regions, as can be seen from the Honolulu specimen, which thrives well in rather dry grounds. The cultivation of this tree has been carried on in India on account of the pods of this species, which contain a very powerful and quickly acting tanning material, and very valuable as a cleaning and brightening agent in the after process of currying.

The propagation of this species is an easy one; one great advantage in its cultivation is that it requires no care after it has once grown up. The ground beneath can be utilized for raising fodder grass and the falling leaves as fuel or manure. The trees are usually planted 22 feet apart.

The plant grows luxuriantly in a clayish calcareous soil, but very slowly in red soils. It can, however, be planted in waste lands in many parts of our islands. The two trees which grow without care or attention bear an abundance of fruit every year, which could be collected and seedlings grown for distribution.

Caesalpinia sappan Linn. Spec. Plant. 381. 1753.
Lignum sappan Rumph. Herb. Amb. 4:56. t. 21. 1743.

Plate 40.

A small tree, prickles small and few, leaf rhachis 0.3 m or less long, pinnae 20-24, leaflets close sessile, subcoriaceous, 20-30, moderately small, oblong, very oblique, attached at the lowest corner; panicles often as long as the leaves, the young branches slightly ferrugineo-pubescent; bracts large, lanceolate, caducous; flowers yellow, stamens little exserted, filaments densely woolly in the lower half; ovary grey velvety; pods thick, polished, indehiscent, with a hard recurved beak at the upper angle; seeds 3-4.

This small tree is a native of India and Burma, and is also distributed through the Malay Isles.

Very few trees can be found in the Hawaiian Islands; the writer is familiar with one in Mrs. Faxon Bishop's grounds on Nuuanu Avenue.

The wood of this species yields a red dye which is very valuable and is largely exported from India. The pods are also used with proto-sulphate of iron to produce a black color. Chips of the wood are steeped in water, which process yields a red color which is intensified by alkalies. The color of sappan is, however, not permanent, as it is formed through the presence of the soluble substance known as Brazilian.

The wood besides being used as a dye is also an useful astringent, containing a large amount of tannic and gallic acids, and on that account has been recommended as a good substitute for log-wood.

The sapwood is white, the heartwood red; it takes a fine polish and does not warp or crack. It is a small thorny tree, suitable for planting in the lowland, especially the drier districts.

PLATE 43.

CAESALPINIA SEPIARIA Roxb.
Wait-a-bit.

Caesalpinia crista Linn. Spec. Plant. 380. 1753. Pro majore parte, excl. Fl. Zeyl. 157 quoad. Herm. Zeyl. 12.

Guilandina bonducella Linn. Spec. Plant. ed. 2. 1:545. 1762.

Guilandina bonduc Linn. Spec. Plant. 381. 1753 pp., excl. Fl. Zeyl. 156

Caesalpinia bonducella Flem. Asiat. Res. 11:159. 1810.

Guilandina crista Small Fl. Southeast. U. S. 591. 1903.

Guilandina bonduc Linn. var. minus DC. Podr. 2:480. 1825.

Caesalpinia jayabo var. *cyanosperma* Maza in Anal. Soc. Esp. Hist. Nat. 19:234. 1890.

Kakalaioa.

Plate 41.

A large prickly scandent or straggling shrub; leaves pubescent, pinnae 6-8 pairs, leaflets opposite, mucronate 6-10 pairs; stipules cut into large segments; flowers yellow, in axillary many-flowered racemes, bracts linear lanceolate spreading, longer than the buds; filaments rusty tomentose; pod coriaceous obliquely elliptic spiny with soft spines; seeds 2-3, lead colored shining, the size of a marble.

This is the common form found in the lowlands in dry and arid regions. It was collected and found on Kauai in Makaweli Valley, in company with *Erythrina monosperma* and *Prosopis juliflora* (no. 2158). On Hawaii it was collected in the valley of Waipio on the windward side, flowering July, 1919, no. 4691, and also at Kalapana, Puna, climbing over lava rocks; it is also common in Kau, at Hilea. It occurs on all the islands.

The *Kakalaioa*, as the Hawaiians call this species, is native of most tropical countries bordering the Pacific. It can be found throughout India, Burma, and Ceylon, as in the Malay Archipelago and many other tropical countries, where it frequents the sea coasts. In India it is known as the "Fever Nut" and "Physic Nut." The seeds contain an oil which is supposedly useful in convulsions and palsy; they are also viewed as possessing well-marked anti-periodic properties and are used by the natives instead of quinine. In intermittent fevers a powder made from the seeds has been found very useful.

Caesalpinia jayabo Maza in Anal. Soc. Esp. Hist. Nat. 19:234. 1890.

Guilandina bonduc Linn. Spec. 381. 1753. pp. quoad Fl. Zeyl. 156.

Caesalpinia bonduc, auct.

Guilandina bonduc Linn. var. majus DC. Prodr. 2:480. 1825.

Guilandina major Small Fl. Southeast. U. S. 591. 1903.

Caesalpinia glabra Merr. in Philip. Journ. Sci. 5:54. Bot. 1910; non *Guilandina glabra* Mill.

Kakalaioa.

Plate 42.

This species comes near *C. crista*, from which it differs in the more robust habit, leaves without stipules, leaflets larger. The inflorescence is naked; flowers fewer and larger; the branches are less downy and armed with fewer shorter and straighter prickles.

PLATE 44.

CAESALPINIA PULCHERRIMA (Linn.) Sw.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

Caesalpinia jayabo is certainly distinct from *Caesalpinia crista:* the flowers are large and in loose racemes, while in the latter they are small and in dense short racemes. Besides *Caesalpinia jayabo* has no stipules, while *Caesalpinia crista* has large foliaceous stipules.

Caesalpinia jayabo is rare in the islands. Heller collected it at an elevation of 2500 feet above Hanapepe Valley on the main ridge west of the Hanapepe River. The writer collected it on the Island of Lanai at about 2400 feet elevation at Waiakiole Valley, where it was climbing over trees and trailing on the ground. The large bright yellow flowers make this climber very conspicuous even from a distance. The plants are much larger in every way and are fartrailing.

It is of wide tropical distribution, occurring in the Eastern and Western Indian Peninsulas, Ceylon, Malay Isles, Polynesia, and the West Indies.

Caesalpinia sepiaria Roxb. Hort. Beng. 32. 1814, nomen nud.

Plate 43.

Wait a Bit.

A scrambling pubescent shrub, forming dense hedges; pinnae 6-10, leaflets 6-12 pair, oblong obtuse; stipules semi-sagittate, deciduous; flowers bright yellow, on long pedicels; stamens slightly longer than petals, filaments densely woolly in the lower half; pod glabrous, obliquely oblong, cuspidate 5-7.5 cm long; seeds 4-8.

This species is rather common, especially on the Island of Oahu. It is of early introduction, as Hillebrand records it as being planted as a hedge. It has escaped and can now be found wild along streambeds on the windward side of Oahu, also common in Makiki Valley, where it forms dense impenetrable thickets. It is known as "Wait a Bit," on account of its nasty recurved spines.

Caesalpinia sepiaria is a native of India, southern China, Japan, and occurs south to Malaya. It has been introduced into many tropical countries and can now be found also in America, Australia, and Africa. In Ceylon and in the Himalayas it ascends to an elevation of 4000 feet.

The plants form impenetrable hedges and on that account should be eradicated if possible. The bark contains tanning and the young pods an essential oil. In Baroda, India, Lac is gathered on this species. The leaves are supposed to be of medicinal value and when bruised are applied to burns.

Caesalpinia pulcherrima (Linn.) Sw. Obs. 166. 1791.
Poinciana pulcherrima Linn. Spec. Plant. 380. 1753.

Plate 44.

A shrub or small tree 3 to 5 m high, branches unarmed or prickles few and scattered on the branches, glabrous; leaves bipinnate, 12 to 24 cm long, pinnae 12 to 18, leaflets 20 to 24, small, oblique-oblong, or obovate to oblanceolate-oblong, subsessile, membranous, 1.5 to 2 cm long, 8 to 9 mm wide, obtuse; racemes very broad, terminal and from upper axils, bearing many showy, variegated, yellow and carmine or pale yellow flowers on long (5 to 7.5 cm) pedicels; calyx lobes glabrous, about 9 mm long; petals usually 1 to 2.5 cm long, round, crisped, with a very distinct claw; filaments bright red, 3 to 4 times the length of the corolla; pod flat, nearly straight, 5 to 9 cm long, 1.5 cm broad above, coriaceous, glabrous; seeds obovate-quadrate, compressed, usually 7 or 8.

PLATE 45.

MEZONEURUM KAUAIENSE (Mann) Hillebr.
Uhiuhi.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

The native country of this species is not known. It is now widely cultivated in the tropics of the world and is not uncommon in the islands of the Hawaiian group, where it is well naturalized. It usually is grown in gardens, but as an escape is found in waste places.

It is an elegant bush, worthy of more extensive cultivation on account of its large red or yellow flowers, which abound throughout the year.

The yellow flowering variety is less common than the red flowering one.

Caesalpinia pectinata Cav., a native of Peru, South America, has been introduced into Hawaii by the writer from Southern California, where the tree is in cultivation under the name of *Caesalpinia echinata*, with which the tree has of course nothing in common. Specimens were grown from seed. Young seedlings were also introduced by the writer from the Bureau of Plant Industry, Washington, D. C., and specimens have been planted out at the College of Hawaii grounds. The flowers of this species are rather inconspicuous and of a greenish color, but the pods, which persist for some time on the small tree, are bright red and contrast well with the dark green glossy foliage. Similar to the Algaroba, the fleshy pods are of value as fodder for live stock.

MEZONEURUM Desfontaines

Calyx with short, very oblique receptacle and 5 imbricate segments, of which the lower is concave and larger than the rest. Petals 5, orbicular, strongly imbricate, subequal. Stamens 10, free, declinate, ovary sessile, 3-5-ovuled. Pod compressed, thin, indehiscent, winged along the upper suture. Seeds flat, without albumen. A tree (or climbing shrubs in foreign species) unarmed in the Hawaiian species. Leaves twice-pinnate; leaflets medium sized and numerous. Flowers red or pinkish purple, in terminal racemes.

About 12 species, all of which, with the exception of the single Hawaiian, are tall climbing shrubs, and are usually armed. The Hawaiian species, *M. Kauaiense* (Mann) Hillebr., is an unarmed tree, and is peculiar to these islands.

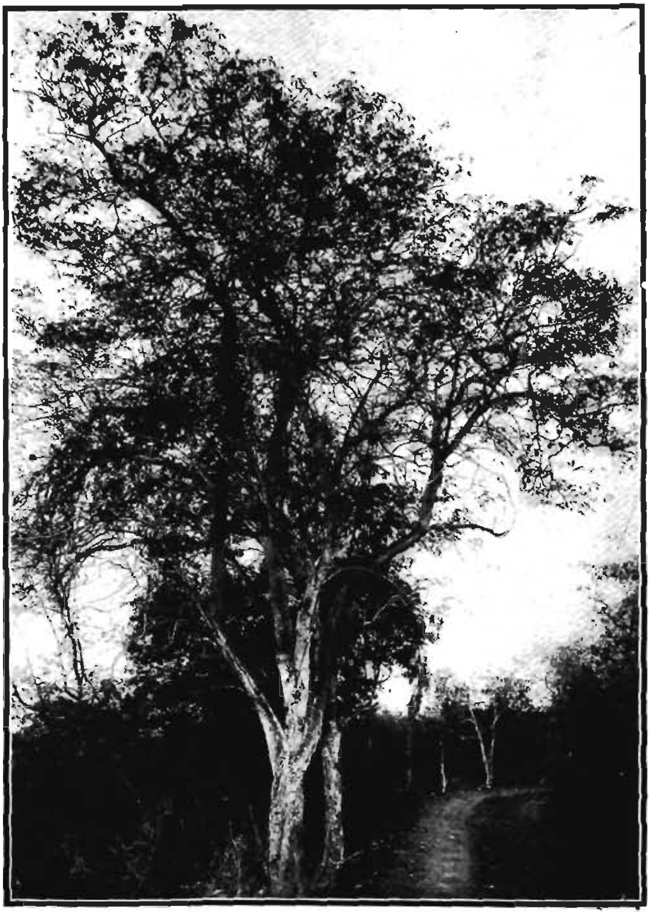
Mezoneurum Kauaiense (Mann) Hillebr. Fl. Haw. Isl. 110. 1888.
Caesalpinia Kauaiensis Mann in Proc. Am. Ac. 7:164. 1866.

Uhiuhi.

Plates 45, 46.

A shrub? or tree 10 m in height with a diameter of trunk of 3 dm or more; bark thick, rough dark gray, checked into rectangular or long oblong plates; branches loose, spreading, unarmed, young shoots covered with a rust to cinnamon-brown pubescence; leaves pari-pinnate, with 1-5 pairs of pinnae, each pinna with 4-8 pairs of leaflets, pinnae 4-8 cm long; the common rhachis up to 12 cm; leaflets oblong, somewhat uneven-sided at the base, emarginate at the apex up to 4 cm long, 16 mm wide, membranous to chartaceous, pale green with rusty-brown pubescent midrib and petiole, the latter 2-2.5 mm; stipules and stipellae none or small wart-like; racemes terminal hoary to rusty-brown pubescent, 12-1? cm long, with flower, 22 cm with fruit, densely floriferous from the base; pedicels 2.5-4 cm long, jointed in the upper fourth, bracts acute, ciliate, 4 mm, caducous;

PLATE 46.



MEZONEURUM KAUAIENSE (Mann) Hillebr.
Uhiuhi Tree growing in North Kona, Hawaii.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

bracteoles wanting; calyx glabrous, pinkish or rose red, the short tube 4 mm, the lowest lobe concave 12-14 mm, the others oblong, obtuse and about 8 mm long, 5 mm wide; petals pinkish purple to rose-red, not or slightly stipitate, shorter than the calycine lobes, the uppermost one obcordate, folded 6-8 mm in diameter, of deeper color (blood red especially towards the apex), the lateral ones suborbicular, the two lowest obovate, 10-12 mm long; stamens exserted, declinate, filaments broad and flat below with reddish brown hair; anthers 2 mm, of carmine color; ovary glabrous, sessile, 3-5-ovuled; style glabrous incurved; stigma small; pod broad obovate-oblong 10 cm long, 6 cm wide, including the 7 mm wide dorsal wing, ending in an uncinate point, flat, thin, indehiscent pale pinkish to gray when old; seeds 2-4, transverse, pale brown, ovate flat 18-20 mm long, 14-16 mm wide, with a punctiform hilum at the base.

KAUAI: Hillebrand in herbarium Berlin and herbarium College of Hawaii:—Puukapele, Waimea Canyon, flowering March, 1909, Rock no. 2435 in herbarium College of Hawaii.

OAHU: Waianae Mts. and Wailupe, Hillebrand.

MAUI: East Maui, Ulupalakua, and West Maui, dry fore hills, Hillebrand.

HAWAII: Between Huehue and Puuwaawaa, North Kona (district of Owei), elevation 2000 feet, flowering and fruiting June 14, 1909, Rock no. 3904 in herbarium College of Hawaii;- same locality, fruiting August, 1915, Rock no. 12591 in herbarium College of Hawaii.

In the Hawaii specimens the dorsal wing does not end in an uncinate point as in the Kauai specimens; at least the point is very obscure. Hillebrand records this species as a shrub, but on Hawaii it is always a tree up to thirty feet in height. The writer has collected it only on Kauai and Hawaii. In the former island it is very rare and perhaps extinct now; from Maui, Ulupalakua, it has disappeared, as the locality recorded by Hillebrand has been entirely denuded of its native vegetation.

According to natives, it exists along Kaupo below the southern outlet of Haleakala crater, Maui, where the natives know it by the name of *Kea*.

The wood of this species is exceedingly hard, close-grained and very durable. It is of almost black color, with a very narrow (one-quarter of an inch thick) sapwood of a light color. The natives made their spears of this wood, also a fishing implement known as *laau melomelo* or *laau makaalei*. The native name of the tree is *Uhiuhi*.

PELTOPHORUM Vogel

Calyx with short receptacle; petals and stamens as in *Mezoneurum*. Ovary sessile, free, rarely elongated, flat, compressed, indehiscent, especially in the middle anastomosely-veined, evenly 2-winged at the sutures. Seeds 1 to 2, compressed without albumen. Tall unarmed trees with twice-pinnate leaves; leaflets small and numerous. Stipules small caducous. Flowers yellow, arranged in paniculate racemes at the ends of the branches.

A genus of about 7 species in the tropics of both hemispheres. One species, *P. inerme* (Roxb.) Naves, is in cultivation in Hawaii.

PLATE 47.

PELTOPHORUM INERME (Roxb.) Naves
Yellow Poinciana.

Peltophorum inerme (Roxb.) Naves in Blanco Fl. Filip. ed. 3, pl. 335. ex F. Vill. Nov. App. 69, as syn. 1880.
Caesalpinia inermis Roxb. Hort. Beng. 90. 1814.
Poinciana roxburghii G. Don Gen. Syst. 2:433. 1832.
Caesalpinia ferruginea Decne. Nov. Ann. Mus. 3:462. 1834.
Peltophorum ferrugineum Benth. Fl. Austral. 2:279. 1864.

Yellow Poinciana.

Plate 47.

A large tree, the young branches, petioles and inflorescence densely rusty-tomentose; pinnae 8 to 10 pairs; leaflets 10 to 20 pairs or fewer on the lowest pinnae, oblong, very obtuse or retuse, oblique at the base 12 to 18 mm long, shining above, minutely rusty-tomentose underneath; racemes 12.5 to 15 cm long or more, forming a large terminal panicle; pedicels very short; bracts small, lanceolate, deciduous; calyx 8 to 10 mm long, globular before opening; petals deep yellow, rather longer, obovate, undulate, villous at the base; pod 7.5 to 10 cm long, up to 2.5 cm broad, shortly acuminate, narrowed at the base, flat, indehiscent, glabrous or nearly so, with one, two or three seeds, and a firm broad wing along each suture.

A native of Ceylon, the Andaman Islands, Malay Peninsula and Archipelago, and also of North Australia.

A very tall handsome tree of early introduction and very commonly planted on all the islands as an avenue tree. It was very plentiful in and about Honolulu till the disastrous storm of December, 1918, when most of the trees of this species were blown down. Its root-system is very shallow, and the heavy crown made it easy for the hurricane-like storm to bring nearly all those to the ground not immediately protected by other trees or houses. Owing to its surface-root-system it is not to be recommended as a street tree.

PAPILIONATAE.

Flowers papilionaceous, rarely almost regular. Calyx usually with united segments, truncate, more or less distinctly 5-lobed or 5-toothed, upper lobes or teeth usually united, the 3 lower also more or less united. Petals usually irregular, 5, the upper the largest and broader than the remaining, known as standard, free or slightly adhering at the base of the staminal tube. Wings free, usually long clawed or connected with lower petals (Keel) at the middle. The two lower petals form the Keel. Stamens usually 10, rarely only 9, occasionally 5 abortive. Filaments entirely or almost free or all monadelphous (united into a sheath) or the upper more or less free from the others (diadelphous). Ovary free, sessile or stipitate, not uncommonly surrounded at the base by a ring- or cup-shaped discus. Seeds variable, sometimes with sparse or entirely wanting albumen. Herbs, suffrutescent herbs, shrubs, or rarely trees with simple, digitate or simple pinnate leaves. Flowers usually of medium size, beautifully colored, often small and insignificant, single, in spikes, racemes or heads rarely in cymes. Pod usually two-valved, dehiscent, occasionally separating in single, one-seeded joints, or indehiscent. Funiculus rarely developed to an arrillus.

KEY TO THE SECTIONS OF **PAPILIONATAE.**

Stamens free.
  Leaves pinnate, shrubs or trees .... **Sophoreae**
Stamens united, monadelphic or diadelphic.
    Pods at maturity separating into one-seeded joints, or hardly jointed .... **Hedysareae**
    Pod at maturity 2-valved or indehiscent.
      Leaves or leaflets without stipelles.
        Leaves simple or digitate with 3 entire leaflets or leafless shrubs, or leaves reduced to scales .... **Genisteae**
        Leaves with 3-toothed leaflets .... **Trifolieae**
        Leaves pinnate.
          Leaf rhachis terminating into a tendril .... **Vicieae**
          Leaf rhachis without bristle or tendril.
            Pod at maturity dehiscing in 2 valves.
              Ovary surrounded by a ring or cup-like discus .... **Dalbergieae**
              Ovary without discus .... **Phaseoleae**
            Pod indehiscent .... **Galegeae**
      Leaves or leaflets with stipelles.
        Pod dehiscing at maturity in 2 valves .... **Phaseoleae**
        Pod at maturity indehiscent .... **Dalbergieae**

I. SECT. **SOPHOREAE.**

Leaves pinnate, leaflets opposite or alternate.
  Leaflets opposite.
    Pod winged, flowers yellow .... **Sophora**
    Pod not winged, large inflated, woody, flowers orange-yellow, calyx colored... .... **Castanospermum**
  Leaflets alternate, anthers longer than the filaments .... **Myroxylon**
Leaves digitately trifoliate, a tall climbing shrub with very large flowers .... **Camoënsia**

II. SECT. **HEDYSAREAE.**

Pod with several joints at maturity separating into one-seeded joints ... **Desmodium**
Pod not jointed maturing underground, leaflets usually 4 (pinnate)..... **Arachis**

III. SECT. **GENISTEAE.**

Shrubs, leafless or the leaves reduced to scales.
  Calyx deeply two-lobed, membranous, colored .... **Ulex**
  Calyx short two-lobed, green .... **Cytisus**
Shrubs or suffrutescent herbs with simple or 3-foliolate leaves; flowers yellow, in terminal racemes or rarely axillary .... **Crotalaria**

IV. SECT. **TRIFOLIEAE.**

Corolla deciduous after anthesis, claws of the petals free.
  Flowers in heads of short racemes, pods spirally twisted .... **Medicago**
  Flowers in long spike-like racemes, pod thick, subglobose or obovate .... **Melilotus**
Corolla persistent after anthesis, claws of all or only the four lower petals united with the staminal tube .... **Trifolium**

V. SECT. **VICIEAE.**

Vexillary petal present.
  Style pubescent, pod more or less compressed.
    Staminal tube terminating obliquely; ovary with several ovules .... **Vicia**
    Staminal tube terminating truncately, style dilated above, the margins bent downward .... **Pisum**
Vexillary petal wanting .... **Abrus**

VI. SECT. PHASEOLEAE.

Leaflets pinnately 3-foliolate, not stipellate.
  Erect shrubby, stigma dilated, oblique, pods acuminate, with depressed lines between the seeds .... **Cajanus**
  A shrub, flowers purple, pod turgid, 10 mm long, 2-seeded .... **Flemingia**
Leaflets not stipellate the stipels replaced by large glands; trees or shrubs with large red flowers .... **Erythrina**
Leaflets stipellate.
  Style bearded below the stigma.
    Stigma oblique.
      Keel spirally twisted .... **Phaseolus**
      Keel not spiral.
        Style filiform, flowers yellow, leaflets entire .... **Vigna**
        Style flattened upwards, flowers blue, leaflets sinuately toothed, root large turnip-shaped .... **Pachyrrhizus**
    Stigma terminal.
      Flowers in racemes.
        Pod flattened not winged, flowers white or purple .... **Dolichos**
      Flowers single, axillary.
        Pod stipitate linear, flowers large blue .... **Clitoria**
  Style not bearded below the stigma.
    Stamens monadelphous, the vexillary filament more or less united with the others.
      Nodes of the raceme not swollen, anthers all fertile .... **Glycine**
      Nodes of the raceme swollen.
        Upper lip of the calyx projecting, distinctly longer than the lower one. .... **Canavalia**
        Upper lip of the calyx not or but slightly exceeding the lower.
          Pod large, turgid, few seeded, fertil stamens six .... **Dioclea**
          Pod small, narrow, elongated, hirsute, many-seeded, fertile stamens ten .... **Pueraria**
  Stamens diadelphous, the vexillary one free from the others.
    Nodes of the racemes swollen.
      Keel exceeding the wings and standard, pods flat, variously grooved or smooth, often with stinging hairs .... **Mucuna**
      Keel and standard equal, wings short, pods thick glabrous not grooved .... **Strongylodon**

VII. SECT. GALEGEAE.

Leaves even pinnate.
  Erect suffrutescent coarse herbs or trees with very large white or red flowers, or yellow flowers and mottled; pods subcylindrical septate between the seeds .... **Sesbania**
Leaves odd pinnate.
  Herbaceous or suffrutescent, if erect shrubs then with subcylindrical pods.
    Anthers apiculate, hairs centrally fixed, erect suffrutescent herbs .... **Indigofera**
    Anthers obtuse, hairs basifixed, pods flat .... **Tephrosia**
  Trees, pods flat.
    Racemes from the branches below the leaves .... **Gliricidia**

VIII. SECT. DALBERGIEAE.

Leaves pinnate; erect trees.
  Leaflets distinctly alternate; pods winged.
    Large trees, flowers yellow, pods orbicular .... **Pterocarpus**
    Flowers small pink or white, pods elongated, narrow .... **Dalbergia**
    A small tree, flowers deep yellow, pod 1-3-seeded, ending in a broad oblong wing. .... **Tipuana**
  Leaflets opposite.
    Pod thick, not winged, tree .... **Pongamia**
    Pod thin, oblong winged, flowers yellow .... **Platymiscium**
    Pod compressed coriaceous, upper suture thickened and dilated, usually one-seeded .... **Lonchocarpus**
    Pod papery, with two wings on both sutures .... **Piscidia**
Leaves simple, fruit drupe-like .... **Inocarpus**

Of all the *Leguminosae* occurring in Hawaii, the tribe *Papilionatae* is represented by more genera and species than the two other tribes together. The strictly native species are very few indeed, numbering in all thirteen. Of these, six are peculiar to these islands: *Sesbania tomentosa*, *Vicia Menziesii*, *Canavalia galeata* (and its variety *pubescens*), *Vigna sandwicensis*, *Vigna owahuensis* and *Sophora chrysophylla*. *Erythrina monosperma* and *Strongylodon lucidus* are also native, but occur elsewhere; the former is found in Tahiti and the latter is apparently scattered over the Pacific Islands to the Philippines, New Guinea, and the Andamans. Apparently native or a part of the native flora, but cosmopolitan species, are *Vigna marina*, *Dioclea altissima*, *Mucuna gigantea*, *Mucuna urens*, *Tephrosia purpurea* and *Canavalia sericea*.

All the other remaining species do not form any part of the native flora, but were all introduced, although a good many are now naturalized and widely distributed throughout the group.

MYROXYLON Linnaeus fil.

Calyx irregularly dentate. Lower four petals free narrow, subequal, standard broadly orbicular. Stamens free or very shortly united at the base deciduous with the petals; anthers acute, longer than the filaments. Ovary long stipitate with two ovules near the apex. Style short incurved with small terminal stigma. Pod stipitate, compressed, indehiscent, with one seed at the apex, attenuating towards the base, two-winged, wing of the upper suture broader than that of the lower. Seeds subreniform. Trees with imparipinnate leaves, rich in balsam; leaflets with transparent glandular dots and lines. Flowers whitish in simple, axillary or at the apex of the branches in paniculate racemes.

There are six described species known, which, according to certain authors, are reducable to two or three.

Two species, *M. Pereirae* and *M. toluiferum*, the two most important ones, were introduced by the writer from the Botanic Gardens of Peradeniya, Ceylon.

Myroxylon toluiferum H. B. K. Nov. Gen. et Sp. Amer. 6:375. 1823.

Tolu Balsam.

A very tall tree; branches glabrous, common petiole 15 cm long; leaflets often 7, alternate, 7.5-10 cm long, up to 5 cm wide or the lower smaller, long acuminate at the apex, rounded at the base, on petiolules of 2-3 mm, coriaceous glabrous on both sides; racemes 15 cm long, simple, in the axils near the apex of branches, solitary or few at the apex of branchlets, the rhachis slightly rufo-tomentose; pedicels solitary 12-18 mm. long; bracts small, revolute, persistent; calyx drooping, 6 mm long, bursting before anthesis into 5 short unequal teeth; standard broadly orbicular retuse; the four lower petals narrow-oblong, or sublinear, shorter than the standard (4 mm); stamens 10, anthers longer than the filaments, the latter the length of the calyx; ovary glabrous, pod 10-12.5 cm long, with a wing about 2.5 cm broad, stalk 8-10 mm long, the marginal wing subparallel, straight or slightly curved, the seed-bearing part falcate-incurved; seed 12-14 mm long, incurved reniform.

It is a native of South America, where it occurs in Paraguay, Venezuela, and Brazil.

It was introduced two years ago by the writer from the Botanic Gardens of Peradeniya, Ceylon. The seeds germinated very freely; germination was 100%. The small trees are rather slow of growth. Specimens of this species and *M. Pereirae* have been planted at the College of Hawaii grounds. This exceedingly valuable and very handsome tree is certainly worthy of being extensively cultivated and planted on account of its wonderful proportions, evergreen foliage, and handsome crown. Seeds of this species should be imported in large quantities, either direct from Brazil or the Gardens above mentioned.

Myroxylon toluiferum produces the resin known as Tolu balsam. The name tolu is derived from a district called Tolu, where the first exploitation of this plant was carried on as early as the sixteenth century.

The trees are tapped similarly to rubber trees, the V-shaped incisions being used. Tolu balsam is extremely soluble in alcohol and chloroform, but less soluble in ether.

The export center of this product is Bolivia. Tolu balsam is used for coughs, pulmonary catarrh, laryngitis, and bronchitis, but is also used in perfumery on account of its delicate odor, which is more readily retained in alcohol, in which it is easily soluble.

Myroxylon Pereirae Klotzsch. in Bonplandia 5:274. 1857.

Peru Balsam.

This species, a native of Central America, was also introduced by the writer from Peradeniya Gardens, Ceylon. It is, like its congenor *M. toluiferum,* a very handsome tree, worthy of extensive cultivation. Specimens are growing at the College of Hawaii grounds.

The product known as Peru balsam is derived from *Myroxylon Pereirae.* It is a soft liquid product of a dark brown color, bitter flavor, but with an agreeable odor.

Peru balsam is used medicinally in the treatment for bronchitis and laryngitis, but is also used in perfumery, owing to its aromatic vanilla-like odor.

The tree is said to produce balsam when five years old; the collecting of the latter begins with the dry season. The balsam is collected from the bark; the latter is beaten on the tree, but not torn or detached from the same. Incisions are made in the beaten bark and a light applied to the openings; the exuding balsam becomes ignited and is allowed to burn for a time. The tree is left undisturbed for three weeks, at the end of which time the balsam begins to flow profusely; it is caught on cotton rags which are stuffed in the incisions. The saturated rags are pressed, placed in earthen vessels with boiling water; the balsam floats to the surface similar to oil and is then collected. It is a thick liquid resembling molasses, but is less viscous.

Tolu balsam, which is derived from another species, *Myroxylon toluiferum.*

PLATE 48.

is absolutely analogous in its chemical composition to Peru balsam, and both are employed for the same purposes.

CAMOENSIA Welw.

Calyx long campanulate, the lobes imbricate. Corolla papilionaceous; petals clawed, crumpled and folded; standard broad, orbicular, the four lower petals narrower, free. Stamens free, with linear, dorsifixed anthers. Ovary stipitate, with many ovules. Style filiform involute in the bud, with a small, terminal stigma. Pod broad-linear, flat compressed, thick coriaceous, two-valved. Seeds horizontal, obovate, compressed, without albumen. Tall climbing shrubs with digitate leaves; leaflets 3, petioled, large, coriaceous. Flowers in simple axillary racemes, very large.

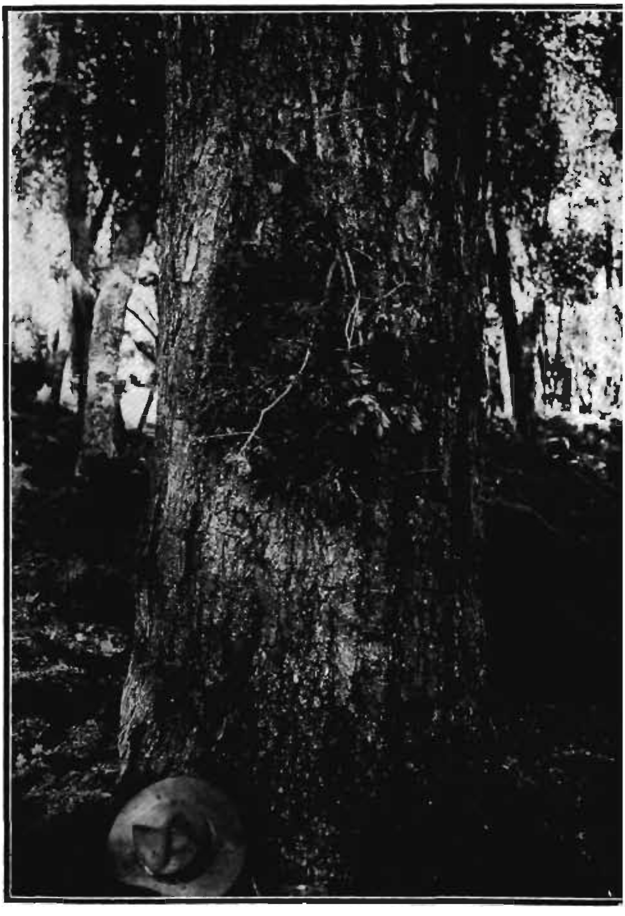
A genus of two species peculiar to western tropical Africa. One, *C. maxima* Welw., a native of Lower Guinea and Congo, is now cultivated in Hawaii. It is the most magnificent species in the subfamily.

Camoensia maxima Welw. ex Benth. in Linn. Trans. 25:302, t. 36. 1866.

A woody climber with terete glabrous branches; stipules rigid and subspinescent; petioles 5 to 6.5 cm long; leaves digitately-trifoliolate, the leaflets with very short petiolules and linear stipellae, obovate-oblong, 12.5 to 15 cm long, narrowed below the middle, cuspidate, subcoriaceous, glabrous; flowers in short-stalked, 6 to 8-flowered axillary racemes; pedicels 2.5 to 5 cm long, downy; bracts and bracteoles lanceolate. Calyx densely coated with reddish woolly tomentum, tubular 15 to 17.5 cm long, the stamens inserted half way up, slit into 5 lanceolate segments 2 to 3.75 cm deep, which are finally recurved; petals cream-colored, with deeper colored veins and a golden border, edges crisped and crenulated, the standard protruding 10 cm beyond the calyx, its limb suborbicular 7.5 to 10 cm broad, the other petals shorter and not more than 2.5 cm broad; pod 15 to 20 cm long, 2.5 to 3.75 cm wide, nearly straight, clothed with ferruginous woolly tomentum, 3 to 4-seeded.

This magnificent species, a native of the Congo, has been recently introduced by Dr. H. L. Lyon and the writer, and plants have been set out at the College of Hawaii Arboretum. The plants were secured from the Bureau of Plant Industry, Washington, D. C., through the courtesy of Mr. David Fairchild, the agricultural explorer in charge. The plant, which is a robust climber, is one of the finest flowering species of the whole subfamily *Papilionatae*. The large white flowers with golden margins, which hang in great profusion from the plant, and which are exceedingly fragrant, make this plant one of the most desirable for an arbor. The writer saw this species in full bloom in the gardens at Singapore, where it seeds rarely. The pods, before reaching maturity, have to be tied up in cheese cloth, as at the period of dehiscence the seeds are expelled with considerable force and are thus apt to get lost.

PLATE 49.



SOPHORA CHRYSOPHYLLA Seem.
Mamani, trunk of tree growing in Kipuka Puaulu, near the Volcano of Kilauea, Ha

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

CASTANOSPERMUM A. Cunn.

Calyx large, colored, with very short, broad, thick teeth. Standard obovate to orbicular reflexed; wings and keel subequal, shorter than the standard, erect, oblong, concave, free. Stamens free, with dorsifixed anthers. Pod long stipitate with many ovules. Style incurved, with terminal, obtuse stigma. Pod elongate slightly curved or nearly straight, swollen, coriaceous to woody, 2-valved, with *spongy tissue between the seeds. Seeds large, subglobose; radicle very short,* straight. Tall trees with impari-pinnate leaves; leaflets large, coriaceous. Flowers large orange to reddish-yellow, in short racemes.

This genus consists of two species, of which one, occurring in New Caledonia, is rather doubtful. The other, *Castanospermum australe* A. Cunn., is a native of subtropical Australia.

Castanospermum australe A. Cunn. & Fraser in Hook. Bot. Miscell. 1:241, t. 51, 52. 1830.

Moreton-bay Chestnut.

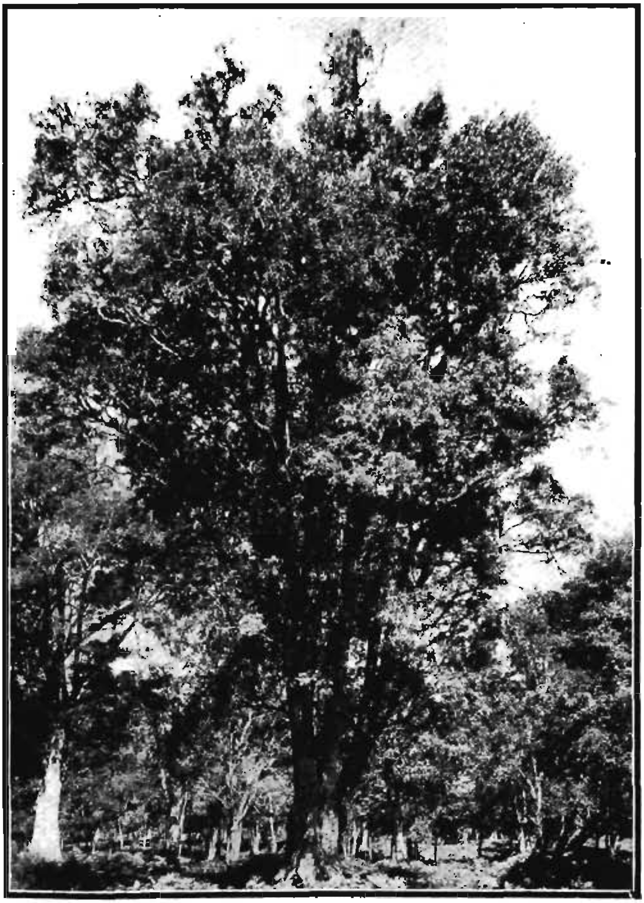
Plate 48.

A tall glabrous tree; leaves 3-4.5 dm long, leaflets 11-15, ovate elliptical or broadly oblong, shortly acuminate, 7.5-12.5 cm long, shortly petiolulate; racemes less than 15 cm long, in the axils of the older leaves or on the leafless older wood; pedicels about 2.5 cm long; calyx 16 mm including the turbinate base; standard orange red, more than 2.5 cm in diameter; pods 20-22.5 cm long about 5 cm broad, slightly falcate, almost terete, the valves ligneous or hard and thick, the spongy substance inside dividing it into 3 to 5 cells, each containing a large chestnut-like seed.

The Moreton-bay chestnut, the common name of this species, is a native of Australia, Queensland and N. S. Wales. The aborigines prepare the seeds for food by first steeping them in water for eight or ten days, after which they are dried in the sun, roasted upon hot stones and pounded into a meal. The seeds when eaten act as a strong laxative, whether previously soaked or roasted. Owing to their highly indigestible character, the beans kill stock, the indigestible portion forming lumps in the stomach, on account of which the cattle owners of Australia have waged war against this tree. The wood of the Black Bean (another name for this species) resembles walnut, to which it is scarcely inferior. It is often very beautiful in its markings, and polishes readily; moreover it is quite durable and will last any number of years underground. In its native habitat the tree often reaches a height of sixty to seventy-five feet, with a trunk of two to three feet in diameter.

This species was introduced by Dr. Wm. Hillebrand, on whose premises, now Mrs. Mary E. Foster's ground, an old tree is still in existence. It flowers in the month of February and later produces numerous pods; the seeds germinate readily. The tree should be much more freely planted. Specimens are growing on the College of Hawaii grounds.

PLATE 50.



SOPHORA CHRYSOPHYLLA Seem.
Growing in the Kipuka Puaulu, Hawaii.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

SOPHORA Linnaeus

Calyx with short teeth. Standard broadly obovate, or orbicular usually shorter, rarely longer than the keel; wing elongate, oblique. Stamens free or rarely united at the base into a ring; anthers dorsifixed. Ovary shortly stipitate, many-ovuled; style incurved, with small terminal stigma. Pod coriaceous, compressed, with two wings in the Hawaiian species. Seeds ovate yellow. Trees or shrubs with impari-pinnate leaves; leaflets small and numerous. Flowers yellow (white or purplish blue not Hawaiian) in simple terminal racemes or panicle.

More than twenty-five species are known; they occur in the warmer regions of both hemispheres. One species with two varieties is endemic to the Hawaiian Islands, the *Mamani* of the natives. *Sophora japonica* L., a native of China and Japan, and *Sophora tetraptera* Ait. were introduced by the writer, the former from Giza, Egypt, the latter from San Francisco, Calif.

Sophora chrysophylla (Salisb.) Seem. Flora Vitiensis 66. 1865.
Edwardsia chrysophylla Salisb. in Transact. Linn. Soc. 9:302, t. 26, f. 1. 1808.

Mamani.

Plates 49, 50.

Young shoots silky pubescent; leaves 15.5 to 15 cm long, with 6 to 10 pairs of leaflets; leaflets obovate oblong, 20 to 36 mm x 8 to 12 mm, obtuse, often retuse, with a cinerous silvery or tawny pubescence (when growing at high altitudes) or glabrous (at low elevation); racemes terminal and lateral, 12 to 25 mm long, tomentose; calyx about 6 to 10 mm, cup-shaped lobes broad and obtuse; petals 25 mm long, yellow, the broad vexilum recurved, the subcrect alae and carina nearly as long; stamens as long as the carina; ovary tomentose; pod 10 to 15 cm long, 8 mm wide, often deeply constricted between the seeds, four-winged; indehiscent; seeds 4 to 8, oval, somewhat compressed, yellow, 8 mm long.

OAHU: Waianae Mts., Keaau, elevation 950 feet, flowering and fruiting January 23, 1919, Charles S. Judd, specimens in College of Hawaii Herbarium.

KAUAI: Knudsen in Herbarium Hillebrand (Herbarium Berlin).

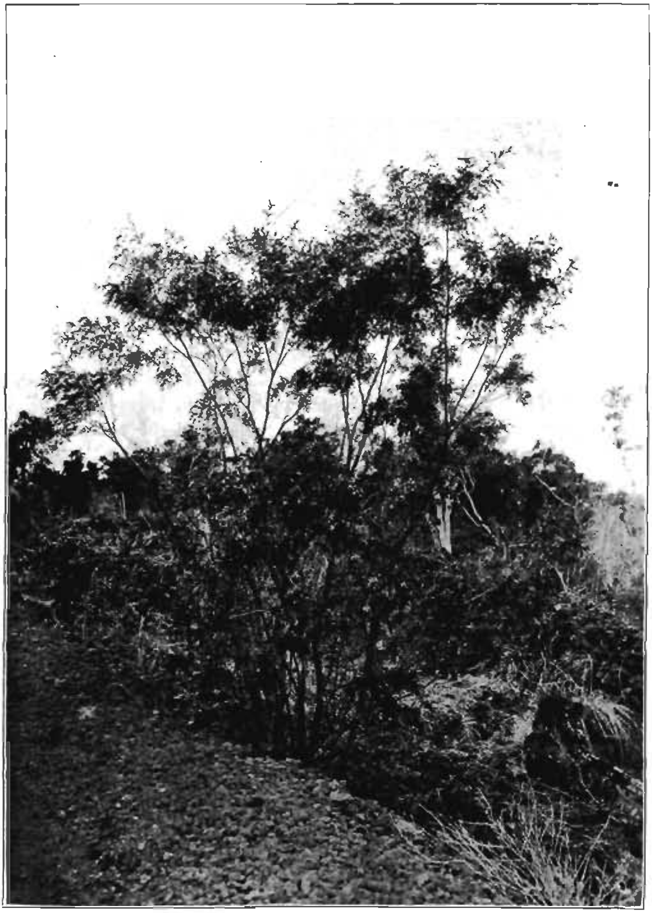
MAUI: Slopes of Haleakala, flowering April 26, 1909, R. S. Hosmer no. 2624 in the herbarium of the College of Hawaii;—Haleakala upper slopes, flowering May, 1911, Rock in herbarium College of Hawaii.

HAWAII: Hualalai upper slopes, elevation 7000 feet, flowering June 9, 1909, Rock no. 3502 in the herbarium of the College of Hawaii;—Mauna Kea, Parker Ranch, 1909, Rock in herbarium College of Hawaii;—Kaluamakani crater, Mauna Kea, flowering July 1, 1909, Rock no. 3225 in herbarium College of Hawaii;—Waikii, Mauna Kea, flowering June, 1910, Rock no. 8418 in herbarium College of Hawaii.

Sophora chrysophylla has also been collected by Menzies, Meyen, the U. S. Exploring Expedition, Remy, Mann and Brigham, Hillebrand, Forbes, Faurie, Curran, and others.

The *Mamani*, which may be found on all the islands with the exception of Molokai, grows from almost sea level up to nearly 10,000 feet elevation. It inhabits the high mountains of Hawaii, Mauna Kea, Mauna Loa, and Hualalai, up to 10,000 feet, where it forms the upper forest zone together with shrubby

PLATE 51.



SOPHORA CHRYSOPHYLLA GLABRATA Rock
Growing on the lava flows of Puuwanwaa, North Kona, Hawaii.

Composites, such as *Railliardia arborea* and *R. struthioloides* and other plants peculiar to these regions. On Kauai and Oahu it never grows to a tree, while on the slopes of Mauna Loa, on Hawaii, near the volcano of Kilauea, it reaches its best development. Trees of 40 feet in height are not uncommon at an elevation of 4000 feet. Below and above the snow-line it is covered with silvery-gray hair, which protects it from the severe cold which it experiences, not only during the winter, but also in the summer months. The writer experienced a temperature of 19° Fahr. during a night spent on Mauna Kea in the month of July.

The specimens from Haleakala have glossy leaves with a gray pubescence; the latter disappears from the upper side entirely, but remains on the lower surface. The Mauna Kea specimens have narrow leaves, as have those from Haleakala, Maui, while the trees from the higher slopes of Hualalai, Hawaii, have broad ovate leaves; the latter specimens have also the largest flowers.

The wood of the *Mamani* is exceedingly hard and durable in the ground. It is therefore mainly used for fence posts by the cattle ranchers on the large estates on Hawaii. On Haleakala, Maui, the trees are of medium size, though reaching a similar development at Auahi as that found near the volcano of Kilauea at Puaulu on Hawaii. On the upper slopes of Haleakala they are shrubby. The wild cattle and horses, which are very numerous on the upper slopes of Mauna Kea, live almost exclusively on the young leaf shoots of the *Mamani* during the dry season, when there is no grass available. But, thanks to the hardiness of the trees, which are exceedingly deep-rooted, they are able to withstand the ravages of the descendants of Vancouver's cattle.

The *Mamani* is peculiar to the Hawaiian Islands, while *S. tomentosa* is found in the South Sea Islands, where it grows on the beach; in Viti or Fiji it is known by the name *Kau ni alewa*, or women's tree.

The *Mamani* is very closely related to *Sophora tetraptera* of New Zealand, Juan Fernandez, Lord Howe's Island, Chatham Island, Easter Island, and Chili.

Sophora chrysophylla glabrata Rock in Bot. Bull. 5:42, pl. 14. 1919.
Edwardsia chrysophylla var. *β glabrata* A. Gray U. S. Explor. Exped. 429. 1854.

Plate 51.

A shrub, 4-5 m high, never a single trunk, more or less glabrate throughout, the leaflets are long, linear-oblong, 2.5 cm long, 6-8 mm wide, glabrate or slightly pubescent on both sides, flowers smaller of a paler yellow, calyx thin, brownish pubescent; the pods (in the Lanai specimens) with very narrow wings, the latter only 1 mm.

LANAI: On the plateau leeward side, near Koele, back of Gibson Homestead, flowering and fruiting July 29, 1910, Rock no. 8012 in the herbarium of the College of Hawaii.

Sophora chrysophylla was first recorded from Lanai, by the writer, and published in his book on "The Indigenous Trees of the Hawaiian Islands." The Lanai plant is certainly worthy of varietal rank and may be classed with Asa Gray's var. *β glabrata*. To this latter variety Asa Gray referred specimens from the lowlands of Hawaii. The writer observed *Sophora chrysophylla* as low as almost sea level at Puuwaawaa, North Kona, and elsewhere on Hawaii.

PLATE 52.

CROTALARIA SERICEA Retz.

The plant from the lowlands of Hawaii belongs in all probability to Gray's var. *β glabrata*, but differs from the Lanai specimens in the much broader winged pods, while the plants from Lanai have wings only one millimeter in width. The variety *glabrata* is always a shrub. It is peculiar to the arid ancient lava flows, where it grows in company with *Myoporum sandwicense*, *Nototrichium sandwicense*, *Dracaena aurea*, *Charpentiera oborata*, *Santalum Pilgeri* var. *luteum*, *Pittosporum Hosmeri*, *Rockia sandwicensis*, etc. At the same elevation on the slopes of Hualalai near Puuwaawaa occurs var. *unifoliata*, a much larger shrub or small tree.

Sophora chrysophylla unifoliata Rock in Bot. Bull. 5:44, pl. 15. 1919.

A tall shrub or small tree, about six meters in height, with more or less straight branches, leaves simple not pinnate, broadly ovate-oblong up to 4.5 cm long, 2.5 cm wide, alternate on the woody branches, on petioles of 2-3 mm, finely pubescent on both sides; floral racemes terminal, pedicels 10-13 *mm*; flowers small, pale yellow; calyx small 4 mm high, pubescent, the lobes very broad and blunt; ovary densely pubescent; pods not seen.

HAWAII: Mr. Young without further locality, 1913, in the herbarium of the College of Hawaii, no. 12648;—Puuwaawaa, slopes of Hualalai, on old aa (rough) lava flow, elevation 2000 feet, flowering August, 1917, Rock type no. 13011 in the herbarium of the College of Hawaii.

This variety was first discovered by Mr. Young of the fibre textile department of the United States Department of Agriculture. The writer met with a single tree at Puuwaawaa. Not one single pinnate leaf could be found on the tree.

CROTALARIA Linnaeus

Herbs or shrubs, various in habit, leaves simple or palmately 3-7-foliolate. Flowers arranged in racemes, either terminal or axillary. Calyx tube short, the teeth linear or lanceolate sometimes unequal. Corolla as long as or exceeding the calyx, usually yellow or yellow and striped; the standard usually round, longer than the wings and keel. Stamens diadelphous. Ovary sessile or stalked; ovules few or many; style bearded upward. Pod inflated, sessile or stipitate, straight or curved.

Crotalaria is a very large genus, found in all tropical and subtropical regions.

Nine species may be found in the Hawaiian Islands, of which two species are not established.

Crotalaria juncea is under cultivation, but has as yet not escaped. *Crotalaria tetragona* was also grown, but its cultivation has been abandoned.

Besides the *Crotalariae* treated in this paper there have been introduced *Crotalaria Belckii*, a southwest African species, described by Schinz in 1888, and *Crotalaria retusa* Linn., an Oriental species, but widely distributed in tropical regions all over the world. They were introduced by Dr. H. L. Lyon for the Hawaiian Sugar Planters' Experiment Station, but are not established in the islands, their cultivation having been discontinued.

PLATE 53.

CROTALARIA ASSAMICA Benth.

KEY TO THE SPECIES.

Leaves simple, petiole not articulate.
  Pods several times longer than the calyx.
    Inflorescence terminal, a many-flowered raceme, pods glabrous.
      Bracts ovate foliaceous, leaves broadly spathulate oblong .... **Crotalaria sericea**
      Bracts linear lanceolate, minute, leaves oblanceolate oblong .... **Crotalaria assamica**
    Inflorscence a lax raceme, terminal or lateral; pods velvety.
      Stem quadrangular, leaves up to 3 dm long, linear, distant .... **Crotalaria tetragona**
      Stem terete-multisulcate, leaves linear oblong up to 8 cm .... **Crotalaria juncea**
  Pod included in the calyx, 2-seeded, flowers in a panicle .... **Crotalaria fulva**
Leaves trifoliolate.
  Pods glabrous or nearly so.
    Leaflets ovate retuse with a small mucro, racemes long, pedicels 3-4 mm, not bracteolate; pod tightly twisted .... **Crotalaria saltiana**
    Leaflets elliptical-oblong, pointed, racemes shorter silky-canescent, pedicels 8 mm bibracteolate; pod oblong .... **Crotalaria anagyroides**
  Pods hirsute to pubescent.
    Leaflets small oblong, mucronulate, flowers long exserted, pods pubescent yellowish-green .... **Crotalaria longirostrata**
    Leaflets larger obovate apiculate, flowers slightly exserted, pods hirsute brownish-black .... **Crotalaria incana**

Crotalaria sericea Retz. Observ. Bot. 3:26. 1779-1791.
Crotalaria spectabilis Roth. Nov. Pl. Spec. 341. 1821.

Plate 52.

A robust undershrub 1-1.5 m high or more; branches subglabrous, stipules foliaceous, persistent; leaves oblong to broadly spathulate-oblong, subacute at the apex or obtuse, cuneate at the base, moderately firm in texture, glabrous above, finely silky beneath, 7.5 cm-15 cm long, 2-5 cm wide, on petioles of 5-6 mm; racemes lax, 20-40 flowered, 3-5 dm long, bracts ovate, foliaceous, persistent, reflexed, pedicels 12-15 mm long, bibracteolate in the lower third; calyx about 15 mm, including the lanceolate lobes of 8 mm in length, the tube campanulate; corolla half as long again as the calyx, yellowish-purple, much exserted; pod 2.5-5 cm long, distinctly stalked, glabrous.

Crotalaria sericea is a native of India, occurring throughout that land, ascending to 3000 feet elevation in Kumaon. It is also distributed through Malacca.

In Hawaii the writer has only found it in moist meadows in upper Nuuanu Valley beyond or near the Country Club, growing luxuriantly near brooks and the Nuuanu Stream bed. It is cultivated in the Punjab (India) as a garden flower, where it is known as Saumi, but is apparently never cultivated as an agricultural product, though fibre is sometimes prepared from it.

It is of early introduction and is recorded by Hillebrand; it has also been collected by Mann and Brigham.

Rock no. 998 in herb. College of Hawaii.

Crotalaria assamica Benth. in Hook. Lond. Journ. Bot. 2:481. 1843.

Plate 53.

A robust undershrub 2 m or more high, branches straight ascending, silky pubescent or puberulous, stipules minute, subulate; leaves oblanceolate-oblong, very shortly petiolate, moderately firm, 15-18 cm long, 2-3.5 cm wide, acute or

PLATE 54.

CROTALARIA TETRAGONA Roxb.
From a specimen cultivated in Honolulu.

obtuse at the apex, mucronulate, cuneate at the base, glabrous above, finely silky below, racemes laxly 20-30-flowered, about 3 dm long; bracts linear-lanceolate, minute; lower pedicels equalling the calyx, the latter 12-15 mm, teeth lanceolate, twice as long as the campanulate tube; corolla deep golden yellow, much exserted, 18 mm deep; pod 3.75-5 cm long distinctly stalked.

Crotalaria assamica is also a native of India, where it occurs in the Khasia mountains at altitudes of 3000-4000 feet. It is distributed over Assam and occurs also in the Philippines, Siam, and China. In Hawaii the plant is known to the writer only from above the half way house on Tantalus, Oahu, where he collected his first specimens of this species on October 24, 1908. When visited ten years later, the species was still found in the same locality. Hillebrand records it as from the Pauoa flats at the head of the valley. It was evidently an early arrival in the islands, but is not mentioned by the early collectors, save Mann and Brigham.

Nothing is known to the writer as to the valuable or injurious properties of this species.

Rock no. 729 in herb. College of Hawaii.

Crotalaría tetragona Roxb. ex Andrews Bot. Reg. t. 593. 1799-1811. Fl. Ind. 3:263. 1832.

Plate 54.

A stiff shrub reaching 2 m in height (in its native habitat) with sulcate thinly silky slender erect-patent, angular branches; stipule subulate; leaves *shortly petioled, distant, membranous, both sides thinly silky, reaching a length* of 3 dm, and a width of less than 2.5 cm, linear-lanceolate, acuminate; racemes lateral and terminal not panicled, laxly six to ten flowered, 15 cm or more long, bracts minute, linear, acuminate; calyx 1.87-2.5 cm long, densely brown-velvety, the lobes very long, linear to lanceolate, acuminate, the three lower usually connate at the apex; corolla lemon-yellow, glabrous, standard large, pointed, wings oblong, rounded, the length of the very broad and beaked, greenish-yellow keel which is brownish pubescent towards the apex; staminal tube short, the filaments very long; ovary pubescent-silky; the style long, slender, glabrous at the base, but bearded along the inner side towards the apex and oblique stigma; pod oblong short-stalked, about 5 cm long, densely and persistently dark brown and velvety, ten to twenty seeded.

Crotalaria tetragona is a native of the northern part of India, where it grows wild in the Himalayas up to 3500 feet in Kumaon, Sikkim, and Assam. It also occurs in Java. Seeds of this species were received by the writer from Mr. Cave, the Superintendent of the Lloyd Botanic Garden, Darjeeling, India. The plants were grown by Dr. H. L. Lyon at the Hawaiian Sugar Planters' Experiment Station. The plants have, however, reached only a height of two to three feet in Honolulu; they are straggly shrubs and evidently of no economic value.

PLATE 55.

CROTALARIA JUNCEA Linn.
Sunn hemp.

Crotalaria juncea Linn. Spec. Plant. 2:714. 1753.

Sunn Hemp.

Plate 55.

An erect, stiff, branched suffrutescent herb, 1 m or more high, finely pubescent throughout and sulcate; leaves simple, linear-oblong to oblong, obtuse at the apex and mucronate, pubescent on both sides but more so beneath, acute at the base, 4-10 cm long, 7-17 mm wide, on petioles of 3-4 mm; racemes terminal 8-20 cm long; flowers scattered, of a golden yellow, 2.5 cm long; calyx densely brown pubescent, the lobes linear-lanceolate, 18 mm long, acuminate; pods sessile, silky brown pubescent, about 3 cm long.

The Sunn hemp is a native of India, but is distributed over Malay to Northern Australia. It has only recently been introduced into the islands, where it is cultivated on Oahu by the Hawaiian Sugar Planters' Experiment Station.

In a state of hay *Crotalaria juncea* contains about 2.29 nitrogen, of which 1.99 is in the form of protein. Analyses made by P. de Sornay showed it to contain:

14.39	per	cent	water
9.94	"	"	ash
27.39	"	"	cellulose
1.12	"	"	fat
32.85	"	"	non-nitrogenous matter
14.31	"	"	nitrogenous matter.

The species is subject to intense cultivation in various parts of Southern Asia, but particularly in India, mainly for fibre, which is extracted from the stem.

When used for this purpose, the stems are cut when in flower, but sometimes the plant is pulled up after the pods have been allowed to mature. The fibre is employed especially in the manufacture of fish nets, after having been tanned. It is also used in the manufacture of paper and other fabrics.

Crotalaria juncea is, however, employed as a green manure: it is then cut at the end of two to two and a half months and ploughed.

It is universally believed by Indian cultivators that Sunn improves the soil, and as such is considered a good preparatory crop. It is grown every second or third year in some of the fields required for sugar cane; sometimes it is sown as a second crop and ploughed in when young as green manure. In dry crop lands it is often grown solely for manure, the plants being ploughed into the soil when ready to flower. The opinion prevails all over India that high cultivation is not necessary for sunn hemp. Further information on this species as a crop plant for the separation of its fibre may be found in the Watt's Commercial Products of India, Vol. II: 595–613.

Crotalaria fulva Roxb. Hort. Beng. 54. 1814.
Crotalaria pulchra DC. Prodr. 2:126. 1825; not Andrews.

Plate 56.

A stiff erect shrub 1-1.8 m in height with copiously paniculate branches branches densely clothed with short stiff brown silky hair; leaves almost sessil-

PLATE 56.

CROTALARIA FULVA Roxb.

subcoriaceous 7.5-10 cm long, about 2.5 cm wide, obtuse or subacute at the apex, cuneate at the base, shining on both sides, with a silky lustre from minute hairs; branches elongated with several bracts flowerless; calyx 12.5 mm or more deep, densely silky, with broad foliaceous teeth, upper teeth oblong, lower lanceolate; with a pair of conspicuous bracteoles; corolla yellow, slightly exserted nearly 2.5 cm in diameter, standard pointed, densely silky on the back, wings of the length of the greenish keel, glabrous, keel glossy shining, as if varnished, also the inner face of the wings but only at the base; stamens included in the keel, the tube broad, glossy, glabrous; ovary silky with white hair especially at the base; pod thinly silky, sessile oblong, two-seeded, about as long as the calyx and included in the latter.

Crotalaria fulva is a native of India, Ceylon, Java, Sumatra, and is naturalized in the Seychelles and Mauritius. In the Hawaiian Islands it was first collected by A. A. Heller in 1895 along Nuuanu Valley road. It is still to be found there, but is not very common; it was collected by the writer recently near the Afong home in Nuuanu Valley, beyond the car line. Nuuanu seems to be the favorite place for *Crotalarias*, as out of six wild species five occur in Nuuanu, and of the five, four have been so far only collected in that valley. They have, however, been cultivated now for experimental purposes at the Hawaiian Sugar Planters' Experiment Station. Nothing is known of the econmic values of this plant.

Crotalaria saltiana Andr. Bot. Rep. t. 648. 1811.
Crotalaria striata DC. Prodr. 2:131. 1825.

Plate 57.

An erect low shrub 6-12 dm high, with robust sulcate, thinly silky branches; stipules minute, setaceous, deciduous; leaflets 3, obovate oblong, obtuse often retuse at the apex cuneate at the base, thin, flaccid, green and glabrous above, pale and obscurely silky beneath, 5-7 cm long, 3-3.5 cm wide, main petiole 4-6 cm long or more; racemes 20-50-flowered terminal and lateral, elongated, bracts setaceous minute, the raceme reaching 36 cm or more in length; calyx thinly silky nearly 1 cm long including the lanceolate, acuminate lobes; corolla twice the length of the calyx, glabrous, yellow, striped with red, keel with a somewhat incurved long beak; pod yellow when mature deflexed, shortly stalked cylindrical, tightly twisted at dehiscence, glabrous, up to 5 cm long, and 20-30 seeded.

Crotalaria saltiana is a native of India, extending from the Himalayas to Ceylon and Malacca; it is, however, widely distributed through the tropics, as the Malay Isles, tropical America and Africa. It is of early introduction, but has not been recorded from Hawaii by Hillebrand. It is, however, well established in the islands, growing in waste places and meadows. On Molokai it is highly prized as fodder and its spread has been encouraged. In India the plant is cultivated for its fibre by the Santals of Chutia Nagpur. Rev. A. Campbell reports that these natives tie a part of the root or portion of the stem to the neck of a person suffering from dropsy.

A form of this species with smaller leaves and silkier stems and calyces is cultivated at the Hawaiian Sugar Planters' Experiment Station, under the name *C. striata*; the plant is referrable to the species discussed.

Rock nos. 174, 176, and 2656 in herb. College of Hawaii.

PLATE 57.

CROTALARIA SALTIANA Andr.
Rattle pod.

Crotalaria anagyroides H. B. K. Nov. Gen. et Spec. 6:404. 1823.
Crotalaria Dombeyana DC. Prodr. 2:132. 1825.
Crotalaria stipulata Vell. Florae flum. 7:307, t. 109? 1827.

Plate 58.

A shrub 2 m high, pubescence always appressed in young parts sericeous (silky); petiole of the same length as the leaflets or little longer, rarely shorter; leaflets 3.75-6.25 cm long, 12-24 mm wide, variably acute or the apex somewhat obtuse, lateral leaflets usually smaller, all glabrous above, more or less appressed puberulous beneath; stipules often inconspicuous, rarely setaceous, 2-4 mm long; racemes terminal, always erect, 10 cm to 2 dm or more long, almost floriferous to the base; bracts setaceous, in young racemes often comose, caducous at the flowering stage; pedicels 4-6 mm, erect-patent; flowers pale yellow; the lateral calycine lobe broadly triangular, the lower narrow; nail of vexillum bearded, as are the interior margins of the carina, to the apex; pod 2.5-4 cm long, thick, subcoriaceous, more or less appressed puberulous or almost glabrous.

Crotalaria anagyroides is a native of Central and South America, widely diffused in meadows and sandy regions as well as in cultivated areas of Northern Brazil.

The plant has made its appearance in Honolulu only in recent years, and is here for the first time recorded. It grows in Nuuanu Valley on the embankment facing the street near Queen Emma Home, this being the only locality where it has been observed in the islands. Formerly, the writer recalls to have seen *Crotalaria sericea* in the exact spot where *C. anagyroides* grows today; the former species can still be found, but farther up in the valley.

Nothing is known as to the value of this plant for green-manuring.

The leaves are the most variable part of the plant; the leaflets may reach a length of 7.5 cm, and are acute at both ends.

No. 12805 in herb. College of Hawaii.

Crotalaria longirostrata Hook. et Arn. Bot. Voy. Beech. 285. 1841.

Plate 59.

Suffruticose, up to 1 m or more high, the branches minutely pubescent, terete, greenish-yellow, leaves on petioles of 12-20 mm, trifoliate, stipules subulate, minute; leaflets elliptical or obovate-oblong, terminal one 20-25 mm long, 8-10 mm wide, obtuse at the apex, mucronulate, the lateral ones smaller, on petiolules of 1.5-2 mm; racemes terminal on lateral about 15 cm long; bracts subulate very small; pedicels 5-6 mm, recurved in fruit; calyx pubescent, the two upper lobes ovate-lanceolate, the others linear-lanceolate; flowers large, yellow, keel with a long straight beak about 15 mm long, exceeding the other petals; pod obovate-oblong, 22-25 mm long, pubescent, shortly stipitate; seeds few, 4-6.

OAHU: Nuuanu Valley in vacant lot, recorded by Mann, Hillebrand, and Heller. The plant is not common, and seems to die down after seeding. It flowers in early December. Rock Coll. Dec. 7, 1917.

Crotalaria longirostrata is a native of Mexico and probably of early introduction here, as it is recorded since the early fifties. It does not seem to have spread, however, the only locality known to the writer being a vacant lot on Laimi Road, Nuuanu, near the old Royal Hawaiian Agricultural Society' grounds. Nothing is known in regard to the usefulness of this species.

PLATE 58.

CROTALARIA ANAGYROIDES H. B. K.

Crotalaria incana Linn. Spec. Plant. 2:716. 1753.

Plate 60.

Plant about 1 m high, erect, branched and suffrutescent, softly gray pubescent, the stems and branches cylindrical; stipules setaceous; leaflets 3, elliptical to obovate, obtuse, or very slightly acute, 2-5 cm long, 1.5-3 cm wide; racemes terminal and lateral, elongated 5-20 cm long, bracts minute, closely 12-20 flowered; calyx about 1 cm long, teeth lanceolate acuminate, longer than the tube; corolla yellow, the standard 10-13 mm wide; pods deflexed, rather recurved, inflated, hirsute 3-4 cm long, 1 cm thick or less, containing 20-30 seeds.

Crotalaria incana is a native of tropical America, but is widely distributed through the tropics, occurring in Ceylon, British India, Malay Isles, Philippines, tropical Africa, and Hawaii. It is occurring in waste places, vacant lots and fields, and is in flower all the year.

There is apparently no record in regard to the usefulness of this species.

Rock nos. 768 and 779 in herb. College of Hawaii.

ULEX Linnaeus

Calyx membranaceous, colored, bilabiate, upper lip bidentate, lower lip tridentate. Petals shortly clawed subequal, free; standard ovate; wings and keel elongate-oblong, obtuse. Ovary sessile, many ovuled. Style slightly incurved with terminal subcapitate stigma. Pod ovoid, elongate or shortly linear, compressed or inflated, shorter or longer than the persistent calyx, two-valved.

Shrubs with thorny branches. Leaves of young seedlings trifoliate, but soon reduced to a small scale or thorn-like petiole. Flowers yellow in the axils of the spines at the ends of the branches or short racemose.

More than twenty species are known in Europe, some occurring in North Africa.

Only a single species, *Ulex europaeus* L., has been introduced on Maui, where it has already escaped and become a nuisance on Haleakala Ranch.

Ulex europaeus Linn. Spec. Plant. 741. 1753.

Furze or *Gorse*.

A much branched bush, 1.5-2 m high, more or less pubescent; branchlets very leafy, tipped with spines; leaves prickly 4-14 mm long, or the lowest sometimes lanceolate and foliaceous; flowers borne on twigs of the preceding season, solitary in the axils, 12-16 mm long, yellow, the twigs appearing like racemes; pedicels very short, bracteate at the base; calyx little shorter than the petals, minutely two-bracteolate; pod few-seeded, compressed, scarcely longer than the calyx.

The Furze, Gorse, or Thorn Broom as the plant is commonly called, is a native of Europe, but is now found in many places throughout the United States. It was introduced on Maui by Mr. Alexander, who planted it as a hedge around his garden near Olinda. Now it can be found all over Haleakala Ranch, where

PLATE 59.

CROTALARIA LONGIROSTRATA Hook. et Arn.

it is a common nuisance. The homestead lands below the ranch are now a veritable jungle of Gorse.

It should by all means be kept from spreading to the other islands and means should be adopted to eradicate it on Maui. There was comparatively little gorse on Haleakala Ranch, as men were employed to pull up all plants and seedlings; but since a large portion of the land above Makawao was turned over to homesteading, naturally the ranch owners stopped from clearing the land not under their control. As homesteaders are far and few between, gorse has taken possession of the land, which is in places a veritable jungle of gorse or furze. If permitted to seed freely, and if left undisturbed for any length of time, it will prove one of the greatest plant pests on Maui.

CYTISUS Linnaeus

Calyx of variable form more or less bilabiate, with short teeth. Petals with free claws; standard suborbicular or ovoid; wings oblong or obovate; keel straight or incurved, obtuse or subacute; ovary sessile, rarely stipitate, many-ovuled. Style incurved, with terminal, capitate or oblique stigma. Pod flat oblong or linear, two-valved, not constricted between the seeds. Unarmed shrubs. Leaves digitate with three or only one leaflet or none. Flowers yellow (purple or white) in terminal short racemes rarely in lateral or apparently axillary racemes.

About forty-four species, occurring in Southern Europe and North Africa.

A single species, *Cytisus scoparius* (L.) Lk., is cultivated on Hawaii, and also naturalized and escaped from cultivation.

Cytisus scoparius (L.) Link Enum. Hort. Berol. 2:241. 1822.
Spartium scoparium L. Spec. Plant. 2:707. 1753.

Scotch Broom.

Stiff, wiry 1.5-2 m high, much branched, nearly glabrous; branches elongate, straight nearly erect, angled; lower leaves petioled, three-foliate, the leaflets obovate, acute or mucronate-tipped 6-10 mm long, entire, narrowed at the base; upper leaves sessile; often unifoliate; stipules none; flowers bright yellow, nearly 2.5 cm long, in elongated terminal leafy racemes; pedicels solitary or two or three together, 6-10 mm long; pod flat, glabrous on the sides, but ciliate on the margins, 2.5-5 cm long; style slender at length spirally twisted or curved.

The Scotch broom is probably cultivated in several places in the islands, especially by some of the Scotch plantation managers, on account of its ornamental value.

It has escaped cultivation on the Island of Hawaii, where it was found by the writer along the road between Honokaa and Parker Ranch, Hawaii, at an elevation of about 2000 feet; it was collected on July 22nd, 1909, and specimens are in the College of Hawaii Herbarium No. 3989.

It is a native of Southern Europe, where it occurs in sandy waste places.

A plant worthy of introduction, belonging to this genus, is *Cytisus pro-*

PLATE 60.

CROTALARIA INCANA Linn.

liferus, which is a small tree. The yield of that species is very high and equal to that of the most productive fodder plants. The beasts which feed on it grow fat, but are lacking in muscle. It occurs in Algeria and throughout the whole of Northern Africa.

MEDICAGO Linnaeus

Calyx short, with five subequal teeth or lobes. Standard obovate or oblong, contracted at the base, straight or reflexed; wings oblong, longer than the obtuse keel. Ovary sessile or shortly stipitate with many or rarely only one hemianatropus ovule. Style subulate to filiform with oblique terminal stigma. Pod projecting from the calyx, straight, reniform, sickle-shaped (drepaniform) or spirally twisted, the spirals at the dorsal suture thorny or tuberculate. Annual or perennial herbs, rarely suffrutescent herbs or arborescent shrubs, with trifoliate leaves, usually toothed. Stipules united with petiole. Flowers usually small, yellow, violet, united into axillary racemes or heads.

About fifty species in Central and Southern Europe, Asia, North Africa, and the Cape Colony. Several species have been introduced and have become naturalized.

Medicago falcata L., *Medicago media* Pers. and *Medicago sativa* L. are the Alfalfa mainly in cultivation.

KEY TO THE SPECIES.

Perennials, flowers violet conspicuous .... **M. sativa**
Annuals, flowers small, yellow.
  Pod one-seeded, curved, very small, black when ripe .... **M. lupulina**
  Pods several-seeded, spirally twisted.
    Pods glabrous, unarmed, spirals 4-5, flattened .... **M. orbicularis**
    Pods spinescent.
      Spines erect, subcanaliculate at the base, rigid .... **M. intertexta**
      Spines divergent, hooked .... **M. denticulata**

Medicago sativa Linn. Spec. Plant. 778. 1753.

Alfalfa.

A much branched perennial, decumbent or ascending 3-4.5 dm high, the young shoots and leaves with some scattered hairs, glabrous when mature; leaves petioled; leaflets oblanceolate or obovate, 4-30 mm long, dentate especially toward the apex, obtuse truncate or emarginate, and often mucronate, narrowed or cuneate at the base; stipules entire; peduncles up to 5 cm long, bearing a dense short raceme of violet or blue flowers; petals about 6 mm long; pod pubescent, twisted into 2 or 3 spires.

A native of Europe, but now widely cultivated fodder and commonly known as the great or Spanish Trefoil, or Alfalfa.

Much has been written about alfalfa in Hawaii, and in U. S. Department of Agriculture Bulletins.

Mr. Krauss of the Hawaii Federal Experiment Station gives the composition of this species as follows:

PLATE 61.

MEDICAGO LUPULINA Linn.
Trefoil.

Water	74.75	per cent
Ash	2.87	" "
Cellulose	7.47	" "
Fat	0.42	" "
Non-nitrogenous matter	8.75	" "
Nitrogenous matter	6.04	" "
	100.00	

And according to the same authority the ash of 1000 lb. of natural substance contains:

Nitrogen	9 lb. 7 oz.
Phosphoric acid	2 " 3 "
Potash	6 " 3 "
Lime	3 " 4 "

For further reference the writer would refer the reader to the Annual Reports of the Hawaii Agricultural Experiment Station.

Medicago lupulina Linn. Spec. Plant. 779. 1753.

Trefoil.

Plate 61.

A pubescent annual, branched at the base, the branches decumbent and spreading, often 1.5-3 dm long; leaves petioled, leaflets obovate, oval or nearly orbicular, variable in size, sometimes 12-16 mm long, denticulate or crenulate, obtuse, mucronate or emarginate, narrowed or rounded at the base; stipules ovate or lanceolate, dentate; peduncles 2.5-7.5 cm long; head oblong, or cylindrical, dense 4-20 mm long, flowers bright yellow, about 2 mm long; pods nearly glabrous, black when ripe, curved into a partial spire, strongly veined, 1-seeded.

The Trefoil, or Blackseed as it is often commonly called, is a native of Europe and Asia, but is now widely distributed as a weed in all temperate regions. In Hawaii it is usually common in meadows at higher elevations, as at Makakalau on Parker Ranch.

Medicago lupulina is of much less importance than *M. sativa* or the lucerne Alfalfa; it is nevertheless useful in mediocre soils which are subject to drought.

Mr. Guthrie made an analysis of *M. lupulina* and gives the following composition for that species:

Water	72.76	per cent
Ash	2.77	" "
Cellulose	4.29	" "
Fat	0.70	" "
Non-nitrogenous matter	12.48	" "
Nitrogenous matter	7.00	" "
	100.00	per cent

Medicago orbicularis (Linn.) All. Flor. Pedem. 1:314. 1785.
Medicago polymorpha orbicularis Linn. Spec. Plant. 2:779. 1753.

An annual with *stems slender, subglabrous, 3 dm or more long; stipules* subulate; leaflets 12-18 mm long, obovate cuneate, faintly inciso-dentate; peduncles shorter than the leaves, 1-3-flowered; calyx about 3 mm, including the linear-setaceous teeth; corolla yellow much exserted; pod 12-18 mm in diameter, with *4-5 flattened spirals, unarmed, vertically compressed, distantly, finely transversely* veined.

Medicago orbicularis is a native of the temperate regions of Europe, occurring also in Abyssinia and in Kashmir in India. In Hawaii specimens have been collected by the writer on Parker Ranch, and specimens have been sent to him for identification from Midway Island, over a thousand miles from Honolulu towards Japan. It was evidently introduced with grass seeds.

Similar to other Medicagos, it is valuable as a pasture plant.

Medicago intertexta (Linn.) Gard. Dict. ed. 8, no. 4. 1768.
Medicago polymorpha intertexta Linn. Spec. Plant. 2:780. 1753.

Stems procumbent, 1 m-1.3 m long, creeping, leaflets obovate, dentate, stipules *ciliate-dentate; peduncles two-flowered; flowers small yellow; pod cochleate, ovate-disc-shaped, pilose, submembranaceous, obliquely reticulate; with thick erect* spines, subcanaliculate at the base.

This species, which is a native of southern Europe, was first noticed by A. A. Heller, about Honolulu, in yards, gardens and grassy places along the streets.

It is of no particular value; on the contrary it is a bad bur-clover, as the spiny pods become attached to the wool of sheep.

Medicago denticulata Willd. Spec. Plant. 3:1414. 1803.

An annual prostrate or spreading, branched, nearly glabrous herb; stems 20-40 cm long; leaflets obovate-cuneate, 1-2 cm long; toothed; stipules laciniate; peduncles axillary, short, *closely 2 to 6-flowered; flowers yellow, about 5 mm* long; calyx teeth as long as the tube; pod with 2 to 4 spirals, the margins pectinate, with spreading spines.

It is a native of Europe and Asia, occurring in China and Japan as well as in the plains and lower hills of Bengal, the northwest frontier province and the Punjab.

It is more or less common on all the islands and is commonly known as Bur clover. Van Dine says it was introduced into Maui in 1882.

It is considered fine forage for sheep, the only objection being the burs which adhere to the wool.

Medicago apiculata Willd. Spec. Plant. 3:1414. 1803.

According to C. N. Forbes this species is also found in Hawaii. He states that it is rare. His specimens came from Honolulu.

MELILOTUS Juss.

Calyx shortly campanulate, with five subequal short teeth, five rarely ten-nerved; standard obovate or oblong, subsessile; the oblong wings longer than the obtuse keel. Upper stamen free or united with the rest at the middle; filaments not dilated at the middle. Ovary sessile or shortly stipitate, few-ovuled. Style filiform, incurved, glabrous, with terminal stigma. Pod oblong, or subglobose, longer than the calyx, thick, straight, indehiscent. Seeds one to three. Annual or perennial herbs, leaves trifoliate; leaflets usually dentate. Flowers small, yellow, white, rarely white and bluish, in axillary slender spike-like racemes.

About twenty species in the temperate and subtropical regions of the old world, one widely distributed in America.

The following were under cultivation at the H.S.P.A.: *Melilotus alba* (sweet clover), *M. coerulea*, *M. officinalis*, *M. sagitalis*, and *M. sulcata*.

Melilotus indica (Linn.) All. Flor. Pedem. 1:308. 1785.
Trifolium indicum Linn. Spec. Plant. 2:765. 1753.
Melilotus parviflora Desf. Fl. Atlant. 2:192. 1789–1800.
Melilotus minima Roth. Nov. Plant. Spec. 361. 1821.

An annual; stems slender 3-5 dm high; stipules linear acuminate; leaflets obovate or oblanceolate, retuse or emarginate; flowering racemes close, fruiting racemes 2.5-5 cm; calyx 1 mm long, teeth deltoid; corolla pale yellow, about 12 mm long; pod 2 mm, obscurely reticulate-lacunose, usually 1-seeded.

A native of India, the Orient, and Europe, but now widely distributed.

Specimens were found by the writer on Oahu at the College of Hawaii farm land. It is probably now distributed through Manoa Valley and elsewhere.

Bees are very fond of this and other species of melilotus. It is considered a fodder plant, but owing to its odor it is generally disliked by cattle.

The following analysis is given by Dr. Leather:

	Green Fodder.	*Hay.*
Water	84.40 per cent	10.00 per cent
Ash	2.26 " "	13.04 " "
Cellulose	4.13 " "	23.83 " "
Fat	0.36 " "	2.08 " "
Non-nitrogenous matter	6.16 " "	32.49 " "
Nitrogenous matter	2.69 " "	18.56 " "
	100.00 per cent	100.00 per cent

Other species in cultivation and probably escaped and now naturalized are *Melilotus alba* Lamk. and *Melilotus officinalis* Willd., but only in the higher altitudes, while *Melilotus indica* belongs to the tropical zone.

PLATE 62.

INDIGOFERA SUFFRUTICOSA Mill.
Indigo.

TRIFOLIUM Linnaeus

Calyx tubular or campanulate, regular or irregularly five-dentate, the lower segments usually longer than the two upper; calyx tube rarely split after anthesis, herbaceous, membranaceous. Standard free or adhering with the remaining petals, oblong or ovoid; wings narrow, longer than the obtuse keel. Nine stamens united, the upper free; anthers all equal. Ovary sessile or stipitate with 2 to 8 ovules. Style filiform often hamatiform at the apex, with terminal, capitate, or dorsal stigma. Pod enclosed by the calyx, linear, oblong or obovate, membranaceous, hardly dehiscing. Seeds 1 to 2, rarely 2-6, subcordate or globose, sometimes lentil-shaped. Erect or prostrate, creeping, annual or perennial herbs, sometimes rooting at the nodes of the stem, often with woody rhyzome. Leaves trifoliate rarely 5 leaflets, leaflets usually dentate. Flowers white, yellow, pink, red or purple in racemes or heads. Inflorescence axillary or apparently terminal.

About 250 species distributed over the temperate and subtropical regions of the old world, also in North America, especially in the western part; only few occur in the mountains of tropical Africa and South Africa.

A number of species have been imported by the cattle ranches and some of the species are more or less established and naturalized. The following were grown by the H.S.P.A., but their cultivation has been discontinued: *Trifolium hybridum*, *T. incarnatum*, and *Trifolium pratense*.

Trifolium repens Linn. Spec. Plant. 2:767. 1753.

White or *Stone Clover*.

Stems slender, glabrous, wide-creeping, stipules narrow; petioles and peduncles long ascending; leaflets obovate emarginate distinctly toothed; heads globose, not dense; flowers finally deflexed; calyx glabrous, the teeth subequal, shorter than the tube; corolla white or with pinkish tinge; pod minute linear three to four seeded.

The white or stone clover is widely distributed through Europe, Asia, and also North America. In the Hawaiian Islands it has been planted by the ranchers to improve the pastures. It is quite commonly met with on Parker Ranch and was collected on the slopes of Mauna Kea at an elevation of 6000-7000 feet in the neighborhood of Moano Crater.

It is by no means, however, well established on Maui. The white clover is more and more spreading, especially on the uplands of Haleakala Ranch at an elevation of between 6000 and 7000 feet.

INDIGOFERA Linnaeus

Calyx small, oblique, campanulate to tubular, with subequal teeth or the lower longer than the rest. Standard obovate, or suborbicular, sessile or shortly clawed; wings oblong, slightly adhering to the keel, the latter straight or slightly curved, obtuse, spurred on each side at the base. Upper stamen free; anthers equal with glandular or penicillate connective. Ovary sessile or shortly stipitate, with many, rarely 1 to 2 ovules. Style short, filiform with capitate often peni-

PLATE 63.

GLIRICIDIA SEPIUM (Jacq.) Steud.

cillate stigma. Pod linear, curved or straight, terete (or quadrangular). Seeds cylindrical. Shrubs, suffrutescent herbs or herbs. Leaves impari-pinnate. Leaflets entire. Flowers usually reddish to purplish-red, in axillary pedunculate racemes or spikes.

About 250 species, distributed over the tropics of the whole world, especially well developed and numerous in tropical and South Africa. In cultivation in Hawaii, *Indigifera Dosua*, and wild naturalized, *I. suffruticosa* Mill.

Indigofera suffruticosa Mill. Gard. Dict. ed. 8, no. 2. 1768.
Indigofera anil Linn. Mant. 2:272. 1771.

Indigo.

Plate 62.

An erect, branched suffrutescent plant, 1 m or more high, slightly pubescent with short appressed hairs; leaves 5-8 cm long; leaflets 9-11, oblong to elliptical-oblong, apiculate, 1-2 cm long, pale and appressed pubescent beneath; racemes axillary solitary 2-3 cm or more long; flowers reddish, about 5 mm long, corolla long exserted; pods numerous, crowded, reflexed, strongly curved, 1-1.5 cm long, 6-8 seeded, slightly appressed pubescent with very short hairs.

Indigofera suffruticosa is a native of tropical America, but is now found in many tropical countries. It was introduced into Hawaii by the Royal Hawaiian Agricultural Society in the early fifties for the purpose of growing it on a commercial scale as an indigo producing plant. It was, however, abandoned afterwards and now the plant may be found on all the islands in waste places, usually in the lowlands.

It was cultivated by the Spaniards in Mexico and by the Portuguese in Brazil as a source of indigo. According to Watt, the dry leaf indigo of Madras, India, is to some extent obtained from this species.

Indigofera Dosua Hamilt. and a variety *tomentosa* of that species were introduced by the writer from the Lloyd Botanic Gardens, Darjeeling, British India. Their cultivation was, however, abandoned; one or two specimens are still growing on the College of Hawaii grounds.

TEPHROSIA Persoon

Calyx with subequal segments or the lowermost longer than the rest. Petals clawed; standard suborbicular; wings obliquely oblong to obovate, slightly adhering to the incurved obtuse keel. Upper stamen free at the base, at the beginning of anthesis united more or less with the remaining ones at the middle, later occasionally entirely free; anthers equal. Ovary sessile, usually many-ovuled, rarely only with two ovules. Style incurved, usually flat, hairy or glabrous, with terminal penicillate, rarely glabrous stigma. Pod linear, flat, two-valved, many-seeded. Herbs or suffrutescent herbs rarely shrubs with impari-pinnate leaves; leaflets many, usually opposite. Flowers white, purple or red, in terminal racemes or leaf-opposed.

About 250 species in the warmer region of both hemispheres, widely dis-

PLATE 64.

SESBANIA GRANDIFLORA (Linn.) Pers.

tributed, especially numerous in tropical Africa and Australia; only few occur in North America. A single species occurs wild in the Hawaiian Islands, not far from the seashore.

Tephrosia purpurea (Linn.) Pers. Syn. Plant. 2:329. 1807.
Cracca purpurea Linn. Spec. Plant. 2:752. 1753.
Tephrosia piscatoria Pers. Syn. Pl. 2:329. 1807.
Tephrosia toxicaria Gaud. in Bot. Voy. Uranie not Pers.

Ahuhu, Auhola, Hola.

Stock perennial and often woody, with slender erect stems 3-6 dm in height, the young shoots silky pubescent; leaflets in 4-6 pairs, linear-oblong, 18-24 mm long, on petioles of less than 2 mm; obtuse or truncate and mucronulate, with tapering base and oblique excurrent veins, but entire; stipules subulate 6 mm; raceme terminal or leaf-opposed, 20-30 cm long, the white-purplish flowers in distant clusters of 3 or 2, or single near the end, in the axils of short stipellate bracts; pedicels 4-6 mm; calyx 5 mm, its teeth subulate; petals near equal in length, 6 mm; ovary silky linear; pod straight, glabrate, 5 cm long, the valves spirally twisted after opening; seeds oblong, 4 mm, flat and sub-reniform, speckled.

A native of tropical Asia, Australia, and Polynesia. The species was originally described from Ceylon.

In Hawaii it occurs on all the islands, on the lee side, usually not far from the sea, in rocky, dry, hot situations, with *Sida*, *Argemone*, *Lipochaeta*, etc. The native names for this species are *Ahuhu* and *Auhola* or *Hola*; the latter name is also employed by the natives of Tahiti for the same species. The plant was used formerly by the natives as a fish poison, as it possesses narcotic properties. The plant was pounded on rocks and then thrown into the water; shortly afterwards fish in the vicinity of the macerated plant would appear floating on the surface in a narcotic state.

In Ceylon the species has been employed as green manure.

Dried samples gave when analyzed:

Water	17.50	In 100 parts of branches, leaves, and tops.
Organic matter	78.85	
Nitrogen	2.24	
Ash	3.65	

Tephrosia candida DC. Prodr. 2:249. 1825.

This species, which forms one of the best, in fact the best, green-manuring plant and ground cover plant in Java, was introduced by the writer from that country in August, 1919. The seeds have already germinated. Dr. van Helten reports that plants have kept for four years, and each year they were cut twice, and each time they sent out splendid, strong, healthy shoots. He considers *Tephrosia candida* the best green-manuring plant for the tropics, Java in particular. It is usually planted extensively in coffee and rubber plantations as a ground cover.

PLATE 65.

SESBANIA TOMENTOSA Hook. et. Arn.

Ohai.

GLIRICIDIA H. B. K.

Calyx with broad short teeth, of which the two upper are somewhat united. Standard large reflexed, occasionally with two small incurved auricles at the base; wings curved-oblong, free; keel curved, obtuse. Ovary stipitate, many-ovuled. Pod stipitate, broadly-linear, not winged, two-valved, not septate, leaves coriaceous. Trees or shrubs) with impari-pinnate leaves; leaflets entire, without stipellae. Flowers pinkish lilac or pink in axillary racemes or from the old wood below the leaves.

The genus consists of about four species, endemic in tropical America.

One species is cultivated in Honolulu.

Gliricidia sepium (Jacq.) Steud. Nomencl. 688. 1821.
Robina sepium Jacq. Enum. 28. 1760.
Gliricidia maculata H. B. K. Nov. Gen. 393. 1823.

Plate 63.

A glabrous deciduous tree 3 to 10 m high; leaves 15-25 cm long; leaflets about 13, opposite, oblong-ovate, slightly acuminate, blunt, base usually rounded, 4-6 cm long, rather pale beneath, green shining on the upper surface; racemes numerous on the leafless branches, densely many-flowered, solitary in the axils of fallen leaves, 4-8 cm long; flowers 2 cm long, pinkish-lilac with a yellow spot on the standard in the medium part, calyx truncate; standard reflexed, retuse; pods narrowly oblong to oblanceolate, 10-14 cm long, about 2 cm wide, flat, 6-8 seeded, tardily dehiscent.

Gliricidia sepium is a native of Mexico, and was introduced first into the islands by Mrs. F. M. Swanzy, who has several specimens growing in her residential grounds on Manoa Road, Honolulu. It flowers rarely in Hawaii. In the Philippines, from where the plant was introduced, it flowers profusely in the Spring, when the tree is bare of foliage; it presents then a very gorgeous sight. In Hawaii the trees do not shed their leaves, which probably accounts for their rarely flowering.

The species should be more commonly cultivated.

SESBANIA Persoon

Calyx broadly campanulate with equal teeth or truncate. Standard ovoid to orbicular; wings oblong-drepaniform; keel long-clawed, incurved, obtuse or subacute. Upper stamen free; anthers equal or 5 alternately longer. Ovary usually stipitate, many-ovuled. Style incurved with small, capitate stigma. Pod linear compressed, terete, or quadrangular or four-winged, two-valved or hardly dehiscing, septate between the seeds. Seeds oblong or square in outline. Shrubs, herbs or small trees with pari-pinnate leaves, leaflets entire, with or without stipillae. Flowers often large, white, red, purplish or yellow, in loose axillary racemes.

About twenty species in the warmer regions of both hemispheres.

One species (*S. tomentosa*) is a native of Hawaii, while *Sesbania sesban*, *S. grandiflora* and its variety *coccinea* are in cultivation.

KEY TO THE SPECIES.

Flowers small, yellow with purple .... **S. sesban**
Flowers, white or red, large.
Flowers 7 to 8 cm long, red or white, a small tree, glabrous........ **S. grandiflor**
Flowers up to 3 cm, bright red, woody plant with procumbent branches, silky pube-cent .... **S. tomentosa**

Besides these three species there has also been in cultivation *Sesbania acu leata* Poir. Specimens were grown at the H.S.P.A.

Sesbania sesban (Linn.) Merrill in Phil. Journ. Sci. Bot. 7:235. 1912.
Aeschynomene sesban Linn. Spec. Plant. 2:714. 1753.
Coronila sesban Willd. Spec. Plant. 3:1147. 1806.
Sesbania aegyptiaca Poir. in Lam. Encycl. 7:128. 1806.
Emerus sesban O. Ktze. Rev. Gen. Pl. 180. 1891.

An erect, branched, stout, shrubby plant, 2-3 m or more high; slightl appressed-pubescent; leaves 10 to 20 cm long; leaflets oblong, rounded, apiculat or mucronate, 2 to 3 cm long, 10-20 pairs; racemes axillary, about 10 cm long few-flowered above the middle; flowers yellow and spotted with purple, slenderl pedicelled about 1.5 cm long; pods subcylindrical slightly twisted, pendulous about 20 cm long, 3 mm wide, depressed between the seeds.

This species extends from tropical Africa, Upper Egypt to tropical Asi and North Australia. In Hawaii the species is sparingly cultivated. Specimen occur in Kalihi Valley, on King Street, and elsewhere. On Kauai it is plentifu in Waimea Valley along the stream bed.

According to von Mueller, the celebrated Australian botanist, the specie is used as a fodder plant, and is said to be much relished by livestock. Th wood of this species, like that of *S. grandiflora* is used in making charcoal fo gunpowder.

Sesbania grandiflora (Linn.) Pers. Syn. 2, no. 316. 1807.
Robinia grandiflora Linn. Spec. Plant. 2:722. 1753.
Aeschynomene grandiflora Linn. Spec Plant. ed. 2, 1060. 1763.
Sesban grandiflora Poir. in Lam. Encycl. 7:127. 1806.
Agati grandiflora Desv. Journ. Bot. 1:120. t. 4, fig. 6. 1813.

Plate 64.

A glabrous tree 5-10 m high, with few virgate branches; leaves 20 to 30 cn long, leaflets 40-60 linear oblong, pale green, glabrous, 2.5-3.5 cm long; raceme short, axillary, flowers 2-4, white, 7 to 9 cm long; calyx green 2.5 cm deep, gla brous, subtruncate or shallowly 2-lipped; pods pendulous, linear 20-60 cm long 7-8 mm wide, somewhat curved, many-seeded.

This species is probably a native of tropical Asia and is distributed fron Mauritius to Australia and Polynesia, but now widely cultivated. It was col lected by the U. S. Exploring Exped. on Oahu, where the species may still b found, but sparingly. It is not wild here, but is found in cultivation only. Th writer knows of a single tree (the white flowering type) in Honolulu, growin

on the vacant lot opposite the Pleasanton Hotel. The red flowering variety (*Sesbania grandiflora coccinea*) was looked upon as a distinct species, *S. coccinea* (Linn. f.) Pers., but is nothing but a mere color form of the widely distributed *Sesbania grandiflora* (Linn.) Pers.

The red flowering variety is now commonly cultivated in the islands and specimens can be seen in Manoa Valley, at the College of Hawaii grounds, as well as in Makiki Valley and elsewhere. It is a very short-lived tree.

Two coloring principles have been extracted from the sap of the trunk, one red, which is called *agathin*, and the other yellow, which is called *xantho-agathin*. Besides these there have been found *arabin*, some *bassorin*, a resinous matter, and tannin. The bark, of which the inner portion yields a good fibre, is astringent. The leaves and flowers as well as pods are eaten by the poorer natives of India in curries and as a vegetable.

Sesbania tomentosa Hook. et Arn. Bot. Beech. Voy. 286. 1842.
Agati tomentosa Nutt. in Herb. Hook.

Ohai.

Plate 65.

A woody plant, with decumbent stems, 5-7 m long; the branches, foliage, etc., silky-tomentose when young, but less so when old; leaves abruptly pinnate, 10-17.5 cm long, very shortly petiolate, leaflets 8-16 pairs, oblong elliptical up to 28 mm long, 6-8 mm wide, pale, glabrous above, silky pubescent beneath even when old, retuse, mucronate; rhachis pubescent; stipules minute, caducous; peduncle up to 25 mm long, two to six-flowered, pedicels about 15 mm long, calyx cyathiform, about 1 cm long, with short deltoid teeth; corolla red or pale salmon-colored; standard orbicular, emarginate reflexed; keel and wings moderately falcate 2.5 cm or more long; stamens and pistil as in *S. grandiflora*; pod 12.5-17 cm long, 3-4 mm wide, glabrous, torulose, and constricted at intervals, slightly stipitate in the nearly persistent calyx; seeds 8-20 oblong, compressed shining.

Sesbania tomentosa H. et A. is endemic in the Hawaiian Islands and is usually found near the sea. It has been collected on Oahu in the district of Waianae, and also on the coast of Hawaii; Hillebrand collected it on Molokai. Specimens of his Molokai plants are in the College of Hawaii Herbarium. The writer collected it also on Molokai, on the sand dunes at Moomomi on the dry west end of that island. It forms dense mats over the white coral sands, covering quite an area. It is always prostrate there, but on Kauai, near Mana, it is a branching erect shrub several feet in height. Mrs. Annie Knudsen of Kauai has kindly sent specimens from the latter locality to the writer. In the Kauai specimens the raceme is six flowered, and the stems are white woolly.

The plant is not known to occur outside the Hawaiian Islands. Specimens are growing and flowering at the College of Hawaii grounds, grown from seed collected by the writer on Molokai.

Recently the arborescent type of *Sesbania tomentosa* has been discovered by Mrs. L. M. Dunbar on the slopes near Mahana on the west end of Molokai. She reports it as a tree 12 to 15 feet in height. The leaves are longer, the leaf-

lets smaller and more numerous than the creeping variety on the same island at the beach sands of Moomomi. It is, however, identical with it with the exception of being arborescent; it may be designated as *Sesbania tomentosa* forma *arborea* Rock f. n.

ARACHIS Linnaeus

Low usually prostrate herbs with even-pinnate leaves, the leaflets 2 or 3 pairs not stipellate. Flowers yellow, crowded in short axillary spikes, or pedicelled in the axils of the leaves. Calyx tube slender, the four upper wings oblong; keel incurved, beaked, standard suborbicular, stamens united in a closed tube, often only nine, the five shorter dorsifixed, anthers subglobose, the alternating ones subbasifixed and elongated; ovary with 2-3 ovules; pod maturing in the ground, oblong cylindrical, reticulate, indehiscent, torulose but not jointed; seeds 1-3, irregularly ovate. Embryo fleshy, oleose, with thick plano-convex cotyledons and short straight radicle.

The genus *Arachis* consists of about seven species, of which six occur in the campos of Brazil. The seventh is commonly known as the Peanut.

Arachis hypogaea Linn. Spec. Plant. 741. 1753.

Peanut.

An annual, spreading, hairy, branched herb, the stems 30 to 80 cm long; leaves 8 to 12 cm long, the base of the petiole clasping, the sheath produced in two linear-lanceolate stipules; leaflets oblong to obovate, 2 to 5 cm long; flowers axillary, few fascicled, yellow, about 8 mm long; pods ripening underground, oblong, coriaceous, reticulate, 1 to 5 cm long, containing from 1 to 3 seeds.

The Peanut is a native of tropical America, but is now widely distributed in cultivation in most tropical and subtropical countries.

Only found in cultivation in Hawaii. Regarding the cultivation of this species for green-manure, M. de Sornay makes the following statement in his valuable book, "Green Manures and Green Manuring in the Tropics":

"We can only urge every sugar-cane grower to make use of the spaces between his canes to cultivate the peanut; it will not only furnish him with a remarkable green manure, but will enrich his soil, lessen the upkeep of his main crop and thus be a source of real profit. When sown between rows of canes, the weight of the stems while still green may vary from 1900 to 2400 kilos. When the stems have reached maturity from 24 to 48 tons (metric) of green manure may be obtained from a full crop."

DESMODIUM Desvaux

Calyx teeth longer or shorter than the tube the upper two often subconnate. Corolla exserted. Standard obovate or orbicular attennate at the base; wings obliquely elongate, more or less adhering to the usually obtuse keel. Vexillary stamen free at the base united with the other towards the middle. Ovary sessile

or stipitate 2 to many-ovuled. Style incurved, with small terminal capitate stigma. Pod exserted usually composed of few to many 1-seeded, indehiscent compressed joints, smooth or covered with minute hooked hairs.

Herbs, shrubs or small trees with simple or three-foliolate leaves, with stipellae. Stipules often membranous and united. Flowers small, pink, purple, bluish or white in terminal or axillary usually branched racemes.

A genus of about 150 species or more, of which the majority are distributed over the tropics of both hemispheres; a few occurring in North America, few in temperate South America and subtropical Australia and South Africa. The genus is absent from Europe, Central Asia and New Zealand.

In Hawaii two species occur as weeds; some are very common, as the Spanish clover, while *Desmodium heterocarpum* is rather rare and has so far only been found in Kalihi Valley.

KEY TO THE SPECIES.

Diffuse shrubs or suberect undershrubs.
Flowers red in long lax racemes up to 3 dm long .... **D. tiliaefolium**
Flowers purplish-blue in dense short terminal and lateral racemes ... **D. heterocarpum**
Perennial herbs, or slender creeping prostrate herbs.
Flowers pinkish-white to purplish in terminal racemes; leaflets ovate-lanceolate. .... **D. uncinatum**
Flowers pink, usually two, opposite the leaves; leaflets very small, obovate .... **D. triflorum**

Desmodium triflorum (Linn.) DC. Prodr. 2:334. 1825.
Hedysarum triflorum Linn. Spec. Plant. 749. 1753.
Meibomia triflora O. Ktze. Rev. Gen. Pl. 179. 1891.

Stems slender and much branched, prostrate or creeping, usually 2.5-5 cm high, pubescent; leaflets 3, broadly obovate or obcordate, 6-8 mm long, or rarely 12 mm long and broad, glabrous, or with scattered silky hair; stipules acuminate persistent; flowers pink or purplish, scarcely 4 mm long, usually two together opposite the leaves; pod sessile 8-14 mm long, slightly curved, pubescent or glabrous, the upper suture continuous, the lower slightly indented, consisting of 3-6, *nearly square joints, which sometimes separate, but frequently* remain attached and open along the lower edge.

Desmodium triflorum is a native of tropics of the old world, but can now be found naturalized in many tropical countries. In Hawaii it has been of early introduction and now one of our commonest weeds on probably all the islands. It is very abundant about Honolulu, in meadows, waste places, along roadsides, etc.

Desmodium uncinatum (Jacq.) DC. Prodr. 2:331. 1825.
Hedysarum uncinatum Jacq. Hort. Schoenbr. 3:298. 1776.

A perennial herb 3-9 dm high, erect or decumbent, in rich ground climbing; leaflets 3, ovate-lanceolate 3.5-7.5 cm long, 12-36 mm wide, glabrous above and generally with white specks or streaks, pubescent along the nerves beneath; the rhachis 36-62 mm long the petioles 3 mm; stipules and stipellae small, subulate;

PLATE 66.

DESMODIUM HETEROCARPUM (Linn.) DC.

racemes terminal and axillary, pubescent 10-15 cm long, naked below: flowers 8-10 mm long, pinkish, often almost white, generally two in the axils of the ovate-acute bracts which measure 8 mm; the bracts soon caducous; pedicels 4-6 mm; calyx 4 mm, its sharp teeth as long as the tube, the two upper approximate. Keel without appendage, pod subsessile 2.5-3.75 cm long, 4 mm wide, mostly curved, strongly uncinate-pubescent, 5 to 10-jointed, the upper suture slightly sinuate or almost straight, the lower notched to the middle and beyond.

Desmodium uncinatum is a native of tropical America, where it extends from Mexico to Chili and Brazil, as well as to the West Indian Islands. It was introduced into Hawaii in the early times and is now well distributed over the whole group, occurring in pasture lands, along the roadsides, and in waste places.

It is a valuable pasture plant and its spread on the various ranches has been much encouraged. It is looked upon as a substitute for clover.

Desmodium tiliaefolium G. Don Gen. Syst. 2:297. 1832.
Hedysarum tiliaefolium Don (David) Prodr. Fl. Nep. 244. 1825.

A large diffuse shrub, stem attaining 5 cm in diameter; wood hard with light brown heartwood, inner bark tough; leaves trifoliolate; leaflets ovate-obovate, rounded or cuneate at the base, cuspidate at the apex, slightly sinuate, secondary nerves 4-6 pair; flowers red in long racemes or simple panicles, on slender pedicels of 8 mm to 12 mm, branches slender, often drooping; pod nearly straight 5-7 cm long, joints 6 to 10.

This species is a native of India, where it occurs in the outer Himalayas, from the Indus to Nepal, at an elevation of from 3000-9000 feet. The writer introduced this species from Darjeeling, British India. Specimens were grown at the College of Hawaii, and were planted out. A few are still surviving and growing on the College grounds. A number of plants were turned over to the Hawaiian Sugar Planters' Experiment Station, but the cultivation of the species has been discontinued.

Desmodium heterocarpum (Linn.) DC. Prodr. 2:337. 1825.
Hedysarum heterocarpum Linn. Spec. Plant. 747. 1753.
Hedysarum polycarpon Poir. in Lam. Encycl. 6:413. 1804.
Desmodium polycarpum DC. Prodr. 2:334. 1825.
Meibomia heterocarpa O. Ktze. Rev. Gen. Pl. 196. 1891.

Plate 66.

An erect or suberect undershrub with woody slightly angular slender branches clothed upward with short appressed hairs; leaves trifoliolate; petiole 1.25-2.5 cm long; leaflets subcoriaceous, green, glabrous above, thinly clothed with appressed gray hairs beneath, the terminal one obovate-oblong, obtuse, 2.5-7.5 cm long, the lateral ones smaller; racemes terminal and lateral, close, short peduncled, 2.5-7.5 cm long, the terminal one sometimes branched; bracts up to 2 mm long, pedicels 2 mm, glabrous; calyx 1 mm, teeth acuminate, exceeding the tube; corolla bluish purple, less than 3 mm long; pod 6 to 9 mm long, glabrescent or minutely downy 5 to 8-jointed.

A native of India, Malay, the Philippines, China, Japan, and Polynesia.

This is the first time that this species was recorded from this Territory. It was found growing wild along the roadside in upper Kalihi Valley.

DALBERGIA Linnaeus fil.

Calyx campanulate, with 5 short unequal teeth. Corolla exserted. Petals clawed; standard ovoid or obovate, broad to suborbicular; wings obliquely elongate; keel obtuse, its petals joined at the tip. Stamens 10, rarely 9, monadelphous or the sheath slit down one side; anthers small, erect. Ovary stipitate, with few ovules. Style usually short, incurved, with small stigma. Pod oblong or strap-shaped, usually thin and flat, 1-4-seeded, the parts opposite the seed thickened with anastomosing veins, indehiscent. Seeds reniform, flat.

Trees or climbing shrubs with impari-pinnate leaves; leaflets usually alternate, without stipellae. Flowers small, purple, violet or whitish to yellowish in terminal and axillary panicles.

More than eighty species in the tropics of the old and new worlds. Two are cultivated in the Hawaiian Islands.

KEY TO THE SPECIES.

Stamens 9, united in a sheath split above; leaflets 3 to 5	**D. Sissoo**
Stamens 10, in two bundles of five each; leaflets 11 to 17	**D. lanceolaria**

Dalbergia Sissoo Roxb. Hort. Beng. 53. 1814.
Dalbergia pendula Tenore Cat. Hort. Neap. 84. 1845.

An erect tree with finely gray-downy branches; leaf-rhachis zigzag; leaflets 3 to 5, roundish, very distinctly cuspidate, firm, glabrescent 2.5 to 7.5 cm long, flowers in short axillary panicles with racemose-corymbose branches; panicles much shorter than the leaves, the erecto-patent branches densely pubescent; pedicels short; calyx 2 mm deep, downy, teeth very short, the lowest rather the longest, lanceolate; corolla yellowish, twice the length of the calyx; standard with a long claw and round limb; stamens 9; pod 1 to 4-seeded, not veined opposite the seeds; thin strap-shaped, pale brown, glabrous, 3.75 to 10 cm long, 6 to 12 mm wide, obtuse with a stalk twice as long as the calyx.

Dalbergia Sissoo is a native of India, where it occurs throughout the plains, extending into Afghanistan and Beloochistan; it is not uncommon in the Central Himalayas, where it ascends to an elevation of 5000 feet.

In Hawaii there is only a single tree in cultivation, which flowers and fruits every year; it can be found at the entrance to the main building of the Board of Agriculture and Forestry on King Street. It is a formidable tree, worthy of cultivation. It would do well to plant this tree extensively in open tracts in dry districts up to elevations of 6000 feet in these islands. The bark is gray and the heartwood brown with darker veins; it becomes a very large tree, but the only objection to it is its deciduous habit.

Dalbergia lanceolaria Linn. f. Supplem. 316. 1781.
Dalbergia frondosa Roxb. Fl. Ind. 3:226. 1832.

A large deciduous tree; leaflets 11 to 17, 2.5-5 cm long, glabrous, ovate or obovate, obtuse, secondary nerves more distinct than the reticulate veins joining them; the two upper calyx teeth obtuse, the three lower acute; flowers in short unilateral, slightly silky racemes, these arranged in large terminal and axillary panicles with spreading branches; calyx brownish purple, corolla pale pink, standard broadly obovate; pod 1 to 3-seeded.

Dalbergia lanceolaria is a native of India and Ceylon, where it occurs in dry regions. It flowers in August and is a beautiful tree when covered with flowers and young leaves. The species was introduced by the writer from the Gardens of Peradeniya, Ceylon, and specimens have already been planted out in the College of Hawaii arboretum.

The wood of this tree is white or yellowish-white, without heartwood.

TIPUANA Bentham

Calyx more or less elongate, tubular, with top-shaped base; the lobes short and broad the 2 upper ones connate. Standard ovate or suborbicular; wings obliquely oblong to obovate; petals of the keel oblong, obtuse. Vexillary (uppermost) stamen free, or all 10 united into a sheath. Ovary shortly stipitate with 1 or few ovules. Style incurved, ensiformly dilated at the base, with small terminal stigma. Pod stipitate, ovoid at the base, thick, coriaceous, with 1 to 3 seeds, terminating into a wing. Tall trees with impari-pinnate leaves; leaflets many usually alternate. Stipules small, caducous. Flowers showy yellow (or bright red) in terminal, loose racemes. Bracts small, caducous, bractlett wanting.

The genus consists of three species, natives of South America. *Tipuana speciosa*, the only one in cultivation in Hawaii, is a native of Brazil, and according to Taubert in Engler and Prantl, also of Bolivia. Two specimens are known to the writer in Kapiolani Park, Honolulu.

Tipuana speciosa Bentham in Journ. Linn. Soc. 4, Suppl. :72. 1860.
Machaerium Tipú Benth. in Hook. Kew. Journ. Bot. 5:267. 1853.

A beautiful tree 4 m or more high; branches (young) puberulous, often glabrous; stipules minute, common petiole 15-25 cm long, leaflets 30 mm long 14 to 16 mm wide, membranaceous, emarginate, bright green, glabrous above, slightly pubescent with short scattered hair below, veins numerous, subparallel; *panicles much shorter than the leaves; loosely and divaricately branched, pedicels* 10 to 12 mm long; calyx 10 mm long, the base turbinate, stipitate, campanulate above, puberulous, green, teeth short, broadly ovate, ciliate, the two upper connate; petals deep yellow, twice as long as the calyx; standard broadly orbiculate, reflexed, marked at the base above the claw; wings broadly falcate, obovate, almost orbiculate, shorter than the standard; keel petals free, much shorter than the wings; vexillary stamen free, the others connate into a sheath; ovary shortly stipitate, silky, villous, 4-ovulate; legume 12 to 18 mm long, 10 to 14 *mm broad, convex, rugosely veined, almost woody, usually 1-3-seeded; wing 6.75* cm long, 16 to 18 mm wide; seeds oblong, incurved.

Tipuana speciosa Benth. is a native of Brazil, where it grows in the province of Tucumana in the Valley of *Tipuana*, the name of which it bears. It is a

PLATE 67.

PLATYMISCIUM STIPULARE Benth.

handsome little tree of about 12 to 15 feet in height, and is known to the natives of that region by the name of Tipú.

The writer knows of only two specimens, both trees 12 feet high; they grow in Kapiolani Park at Waikiki, along the car track near the Aquarium. Who introduced and planted it in Hawaii is not known to the writer. It flowers in April. The flowers are of a deep orange yellow color.

Nothing is known in regard to the usefulness of this species.

PTEROCARPUS Linnaeus

Calyx turbinate, curved in the bud, the teeth short, the two upper segments more or less united. Standard broad, ovate or suborbicular; wings obliquely obovate to elongate; the keel petals of the shape of the wings or shorter free or dorsally slightly united. Staminal sheath split above and below or only above, the upper or vexillary stamen often nearly or quite free. Ovary sessile or shortly stipitate, with 2-6 ovules. Style filiform, incurved, with small terminal stigma. Pod compressed orbicular or ovoid usually 1-2-seeded, indehiscent, and surrounded by a broad wing.

Trees with impari-pinnate leaves; leaflets alternate or nearly opposite; stipules usually small, often invisible. Flowers yellow, rarely white with violet, in terminal or axillary simple or panicled racemes.

Pterocarpus consists of about 20 species, distributed in the tropics of both hemispheres. Perhaps three species are cultivated in the islands.

Seeds of *Pterocarpus echinatus* Pers. have been imported by the writer from the Philippines, but not a single plant was raised from it, as the seeds spoiled in transit. There are still two more species in Dr. Hillebrand's garden, but as no flowers or fruits have been observed their identity remains doubtful.

Pterocarpus indicus Willd. Spec. Plant. 3:904. 1800.

A tree reaching a height of 25 m or more with ascending glabrous branches, leaves 15 to 30 cm long; leaflets 7 to 11, ovate to oblong-ovate, acute or bluntly acuminate, glabrous, rounded or deltoid at the base, 5 to 10 cm long, alternate, shining; petioles 6-8 mm; main veins fine, distant; panicles axillary branched; flowers numerous, yellow, about 1.5 cm long; the panicles clothed with a fine brown pubescence; pedicels 6-8 mm with a pair of linear spreading caducous bracteoles at the apex; calyx 6 mm long, finely brown silky; teeth rounded, the two upper much the largest; corolla exceeding the calyx; standard up to 12 mm broad; young pods pubescent, glabrous or nearly so when mature, orbicular to obovate, including the wing 4 to 5.5 cm long, the wing 1 to 1.5 cm wide, more or less reticulate and undulate, very shortly beaked.

Pterocarpus indicus is a native of India, Burma, the Malay Isles, Philippines, and China. It is the well-known *Narra* of the Philippines.

In Honolulu there are very few specimens of this species in cultivation; the finest tree may be seen in A. Young's premises on King Street and Thomas Square. One old tree is in Mrs. Mary E. Foster's garden on Nuuanu Street. This handsome species is certainly worthy of cultivation, and it is a pity that no young plants were grown from the seeds abundantly produced by this tall

PLATE 68.

LONCHOCARPUS SERICEUS (Poir.) H. B. K.

tree on King Street. The species will also grow readily from cuttings, a method much employed by the Bureau of Forestry in the Philippines. Specimens were grown from seed by the writer and planted at the College of Hawaii campus.

Pterocarpus sp.?

Specimens (seedlings) were imported by the writer from the Forestry Station at Los Banos, Philippine Islands; they came from the mountains back of the Station and cannot now be identified; they have been planted at the College of Hawaii campus.

PLATYMISCIUM Vogel

Calyx campanulate with obtuse, nearly equal teeth. Standard orbicular or ovate; wings obliquely elongate; petals of the keel united only at the apex, straight or slightly incurved. Staminal sheath split above; anther cells converging at the apex. Ovary long stipitate, with one ovule. Pod elongate, flat, stipitate, subcoriaceous, with thin or hardly thickened margins. Seeds large, reniform, flat.

Trees or shrubs with opposite impari-pinnate leaves; leaflets opposite. Flowers yellow, in racemes.

About fifteen species in tropical America. Only one single species cultivated in Honolulu, represented by a single mature specimen.

Platymiscium stipulare Benth. in Journ. Linn. Soc. 4. Suppl. 82. 1860.

Plate 67.

A tall tree 20 m or more high, with numerous ascending branches; leaves usually five-foliolate, the petiole including rhachis about 10 cm, petiolules thickened, 10 mm long; leaflets elliptical, glabrous, acute or rounded at the base; acuminate at the apex, 7.5-13 cm long, 3.5-6 cm wide, subcoriaceous, glossy, shining above, dull underneath, with prominent nerves and undulate margins; racemes axillary in pairs, 15-16 cm long, floriferous three-fourths its length, puberulous, flowers fascicled in pairs on each side; pedicels 5 mm; calyx truncate, irregularly toothed, campanulate; corolla yellow; standard suborbicular, but attenuate to cuneate at the base, keel and wings subequal obovate, long clawed, auriculate; staminal sheath glabrous, as is the long stipulate pistil; style filiform, stigma obscure; pod long stipitate, oblong, chartaceous, flat, 8-10 cm long, 3-3.5 cm wide, with numerous anastomosing nerves; seeds flat, greenish, reniform to oblong, 22 mm long, 11 mm wide.

This rather handsome tree is a native of Peru. It was introduced by Dr. Wm. Hillebrand, in whose former residential grounds a tall specimen flowers and fruits abundantly. The tree volunteers very freely; hundreds of seedlings can be found scattered all through the spacious grounds; it is a strong, vigorous, and rapid grower. Plants of this species have been set out on the College grounds, where they are doing fine. The tree should be propagated by all means, and should be freely planted in our lower mountain ranges.

PLATE 69.

PONGAMIA PINNATA (Linn.) Merrill

LONCHOCARPUS H. B. K.

Calyx mostly cupulate truncate or toothed. Standard usually suborbicular, rounded to emarginate at the apex, wings oblique-oblong, to falcate adhering to the keel above the claw; carinal petals obtuse, cohering by the carinal margin. Stamens monadelphous. Ovary sessile or stipitate, 2-9 ovulate; style slender, the stigma usually capitellate and small. Legume broadly ovate coriaceous, the vexillary suture thickened or slightly winged, seeds one to four, flat compressed, reniform.

Trees (or shrubs) with impari-pinnate, alternate leaves; leaflets opposite. Flowers purple, white or pink, solitary or geminate. Inflorescence racemose, simple or ramified.

The genus extends over tropical America, tropical and South Africa, Madagascar, and Australia. The species number about seventy, forty of which, according to Pitier, are found in Middle America.

In Hawaii only one species is in cultivation. *L. sericeus;* a white flowering species, which does, however, not seed and can therefore not be identified, grows in the old Spreckels place on Punahou Street. It is a handsome tree and flowers profusely before the appearance of the leaves.

Seeds were imported of a species under the name of *Lonchocarpus formosianus* DC. That name appears as a synonym of *L. sericeus* H. B. K. in Index Kewensis; but in Flora Brasiliensis it appears as a synonym of var. *β glabrescens* of *L. sericeus*.

Specimens were set out on the College campus.

Lonchocarpus sericeus (Poir.) H. B. K. Nov. Gen. et Spec. 6:383. 1823.
Robinia sericea Poir. in Lam. Encycl. 6:226. 1804.

Plate 68.

A small to medium sized tree, the branchlets, rhachises of the leaves and those of the inflorescence more or less ferruginous-pubescent; leaves 7-13 foliolate, canaliculate, the pubescence dense at first, more or less evanescent later; leaflets coriaceous, the costa and veins deeply impressed above, prominent beneath, the petiolules 4-6 mm long, the blades ovate, obovate or oblong, rounded at the base, rounded obtuse or shortly obtuse-acuminate at the apex, minutely pubescent, principally on the costa and veins beneath; racemes solitary in the axils of the upper leaves, 9-24 cm long; peduncles and pedicels densely ferruginous pubescent, the former solitary or two or three together and then two-flowered; bracts and bractlets ovate-orbicular; calyx cupulate, subtruncate about 5 mm long, densely ferruginous pubescent without; petals purplish, standard suborbicular, biauriculate at the base, emarginate at the apex, densely silky pubescent without and within above the claw, wings adhering to the carina, rounded auriculate at the base on the vexillar side, carinal petals mostly free, falcate, auriculate, silky pubescent on the upper half; vexillar stamen free at the base, the tube broadened auriculate, leaving an ovate opening on each side of the former; ovary sessile and thickened at the base, densely canescent pilose; style arcuate, hairy at the base *only, stigma capitellate, legume compressed, attenuate at the base,* acute at the apex, fulvous pubescent, the vexillar suture thickened, sharp on the edge, seeds usually one, rarely two in specimens growing in Hawaii, legume ovate oblique, about 5 cm long; seeds oblong-reniform, surrounded with a coriaceous endocarp.

PLATE 70.

PISCIDIA ERYTHRINA Linn.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

This species, which is a medium sized to small tree, is a native of Mexico, Cuba, Porto Rico, Martinique, Trinidad, and is widely spread over the West Indies, extending to Mexico in one direction and to Columbia and Brazil in another. Its area of dispersion includes also western tropical Africa, according to Bentham.

The tree was introduced to Hawaii from Brazil by Dr. W. Hillebrand, probably in the early sixties; there is only one mature tree in the islands which produces seeds regularly every year; it can be found in the garden of Mrs. Mary E. Foster's estate on Nuuanu Avenue, formerly the home of Dr. W. Hillebrand.

It is a valuable tree and should by all means be cultivated; it would do well to plant it in the drier regions or moist low country. It is not a very rapid grower, as can be seen from experimental plantings on the College grounds, where two specimens have been planted out two years ago. They were grown from seed of the tree in Mrs. Foster's grounds.

The wood is hard, fine-grained, and could be put to many uses.

The species is more or less fond of the rocky, half-denuded slopes of lower hills or of stony flats and sea beaches. It is restricted to the lower belts up to 3000 feet in the drier regions. The bark of this tree, which is very common near the sea in Gaboon, Africa, is used medicinally as a laxative in infantile abdominal troubles.

PONGAMIA Ventenant

Glabrous tree with odd-pinnate leaves, the flowers in axillary racemes; calyx campanulate or cup-shaped, truncate or subtruncate. Corolla exserted, the standard broad, the keel obtuse. Stamens monadelphous, the upper filament free nearly to the base. Ovary 2-ovuled; style incurved. Pod woody, flattened, oblong, indehiscent, not winged or thickened along the margins.

A genus of a single variable species, native of tropical Asia and Australia. Cultivated in Honolulu.

Pongamia pinnata (Linn.) Merrill in An Interpr. of Rumph. Herb. Amboin. 271. 1917.

Cytisus pinnatus Linn. Spec. Plant. 741. 1753.

Robinia mitis Linn. Spec. Plant. ed. 2. 1044. 1763.

Pongamia glabra Vent. Jard. Malm. 1:28, t. 28. 1803.

Galedupa pinnata Taub. in Engl. et Prantl. Nat. Pflanzenfam. 3³:344. 1891.

Pongamia mitis Merrill in Phil. Journ. Sci. 5:101. Bot. 1910.

Plate 69.

A tree 8 to 25 m high, glabrous throughout, branches scandent or drooping, leaves 20-25 cm long, common petiole glabrous 12 cm long; leaflets 5-7, 7-9, oblong-ovate to ovate, acuminate or rounded at the apex, rounded or attenuatingly obtuse at the base, 7.5-15 cm long, 25-80 mm wide, the terminal one larger than the others; petiolule 6 mm; inflorescence an axillary raceme 15-20 cm long, pedicels 6-8 mm, bibracteolate below the apex; flowers numerous, white, purplish or pink, about 1.5 cm long; calyx campanulate, 3 mm long, 7 mm wide, truncate, petals clawed; standard orbicular, 10 mm in diam.; wings and keel oblong,

obtuse and pubescent; pistil pubescent, 2-ovulate; pod ligneous, glabrous, 35-50 mm long, 20-30 mm wide, 5-8 mm thick, shortly beaked at the apex; seeds one rarely 2, 17-20 mm long, 12-18 mm wide.

Pongamia pinnata is widely distributed through the tropics, from the Philippines to India, Seychelle Islands, Malaya, Australia, and Polynesia. It is usually found along tidal streams and near the sea; it flowers in October, also in January and February.

The leaves are extensively employed in India as manure for wet cultivation. The leaves are said to be effective in destroying blight, as all information on the qualities of the leaves seems to point to their being more or less antiseptic.

The seeds of *Pongamia pinnata* produce an oil which is anti-soporific. It is used in the treating of scabies, herpes, ulcers, and rheumatism. It is also claimed that the oil expressed or obtained from the seeds of this tree possess all the advantages of iodoform and Goa powder without their drawbacks.

The leaves of this species are a valuable fodder for livestock.

Owing to the handsome appearance of this tree and its rather rapid growth it is well adapted for avenue plantings. When in flower it presents a very pleasing aspect, and the fragrance of the wistaria-like inflorescence adds much to its agreeable appearance. As has already been stated the oil of the *Pongamia pinnata* is used medicinally; it has a poisonous smell and a bitter flavor; its color changes to vermillion in the presence of sulphuric acid.

The wood of this species is fairly hard, white, handsomely grained, and is much employed in cabinet-making, besides being used as fuel.

Only very few specimens of this species occur in Hawaii; in fact the only ones known to the writer occur on the premises of Mrs. Mary E. Foster on Nuuanu Avenue, the former residential grounds of Dr. Wm. Hillebrand, who introduced the tree from India. Specimens have been grown from seeds of the Honolulu trees and planted in the College of Hawaii Arboretum.

PISCIDIA Linnaeus

Calyx subcampanulate, with the teeth short and wide, the two upper ones slightly adhering. Standard orbicular, wings oblong falcate, petals of the keel adhering along the back. Upper stamen free at the base, united with the others at the middle in a close tube. Ovary sessile with numerous ovules; style reflexed, filiform, the stigma small terminal. Pod linear flat, the sutures widening into 2-veined wings; seeds ovate, compressed. A tree with impari-pinnate leaves; leaflets opposite, flowers white or cream-colored and blood red in short panicles. Bracts opposite on the pedicel, caducous.

The genus consists of two species, one a native in the West Indies, Mexico, and Florida, and the other of Mexico as far as known. *P. Erythrina* is cultivated in Hawaii.

Dr. J. N. Rose described a second species from Mexico, *P. mollis*.

Piscidia Erythrina Linn. Spec. Plant. ed. X: 2:1155. 1759.
Piscidia piscipula Sarg. in Gard. & For. 4:436. 1891.

Fish Poison Tree.

Plate 70.

A tree 20 m high, leaflets 3-5 jugate, pubescent or glabrescent, oblong or elliptical, pointed or blunt, dark green above, paler underneath, conspicuously veined; flowers in short racemes; flowers 1.2-1.6 cm long; standard orbicular; wings each 1.2-1.6 cm broad, transversely striate, lacerate or repand; pod 5-10 cm long, 8 mm broad, puberulous, papery, six to eight-seeded; seeds transversely oblong, black, 7 mm long.

This species is a native of the West Indies, Mexico, and the southern part of North America.

In Honolulu there are quite a number of trees in cultivation, especially on *Thomas Square*. It flowers usually before the appearance of the leaves and is then an object of great beauty. It is a slow grower, but should be more commonly cultivated.

From the bark of *Piscidia Erythrina* an alkaloid has been isolated which gives crystallizable salts known as Piscidin; the formula is $C_{29}H_{24}O_8$. The alkaloid obtained has sedative and soporific properties, and remarkable results have been obtained in the treatment of neuralgia of the lumbar and abdominal regions. It has also been successfully used in treating hysteria, chronic alcoholism, chronic bronchitis, gastralgia, and neuralgia.

In the West Indies the bark is employed in stupefying fish, which gave it the name of *Fish poison tree*.

INOCARPUS Forster

Calyx tubular or campanulate, irregularly 2-5 toothed; petals free or united at the base with the stamens into a tube, linear, subequal. Stamens 10. Ovary sessile or very shortly stipitate with 2 or less ovules. Style short with oblique stigma. Pod shortly stipitate, subdrupaceous or coriaceous, 2-valved.

Glabrous trees with short petiolate simple large leaves with small stipules. Flowers cream to yellow in axillary (spikes) racemes. Bracts small caducous; bractlets small. A genus of about three species, of which two are not well known. *I. edulis* is the one commonly cultivated.

Inocarpus edulis Forst. Char. Gen. 66, t. 33. 1776.
Bocoa edulis Baill. Adansonia 9:237. 1868–1870.

Tahitian Chestnut.

Plate 71.

A tree with long drooping branches, glabrous, leaves simple large oblong, coriaceous, acute or obtuse at the apex, cordate at the base, very shortly petiolate; stipules small; spikes axillary; flowers white; calyx tubular-campanulate 2 to 3-lobed; petals 5, united into a tube at the base, linear, subequal, imbricate; stamens 10, adnate in the tube of the corolla, anthers small; ovary subsessile; style short with an obliquely dilated-concave stigma; pod about 7 cm long, 5 cm wide and about 4 cm thick, subdrupaceous, shortly stipitate, obovately incurved, endocarp thick fibrous, one-seeded; seed broadly ovate, albumen not

INOCARPUS EDULIS Forst.
Tahitian Chestnut.

This curious tree, commonly known as the Tahitian Chestnut, is ubiquitous in Fiji; it occurs on many of the islands of the Pacific, as Tahiti, New Guinea, etc. In Hawaii only a very few specimens can be found; Dr. W. Hillebrand evidently introduced it, as there are two large specimens growing in what used to be his former residential grounds. It is of exceedingly slow growth, and here in Honolulu has a rather straggly appearance. In Fiji it inhabits the rich bottoms of the valleys along the banks of streams. The trunk becomes buttressed when old. The flowers are very fragrant, and notwithstanding their smallness are esteemed by the natives. When breadfruit is scarce the Fijians supply the deficiency with the *mape* or *rata*, as they call the fruit of this curious tree. The seeds are either boiled or roasted before being eaten.

VICIA Linnaeus

Calyx tube oblique and usually obtuse at the base, the five segments subequal or the two upper shorter, the lower one commonly longer than the others. Petals shortly clawed; standard obovate-ovate, emarginate, attenuate at the base in the short and broad claw; wings obliquely elongate adhering to the keel at the middle; the latter elongate, curved, shorter than the wings. Vexillary stamen free or with the remaining more or less united. Ovary subsessile or stipitate with several, rarely only 2 ovules. Style slender incurved, bearded on the dorsal side, or more or less hairy around the apex, rarely glabrous, with terminal stigma. Pod compressed, with membranous, rarely subcoriaceous or somewhat fleshy pericarp, 2-valved. Seeds globose or slightly compressed with a thin arillus.

Annuals or perennials usually herbs climbing by means of tendrils. Leaves pari-pinnate; leaflets entire or dentate at the apex, the terminal one usually substituted by a tendril, or in place of the terminal leaflets a recurved bristle. Flowers usually blue, violet, yellowish or whitish, single or to three, sessile in axils of the leaves or in more or less dense dorsiventral racemes.

About 120 species, distributed in the temperate regions of the northern hemisphere and in southern and western South America.

A single species, *Vicia Menziesii* Sprengel, is endemic in Hawaii; the other species are either cultivated or naturalized.. *Vicia faba* is also under cultivation.

KEY TO THE SPECIES.

Stems slender, suberect, stipules small obliquely lanceolate .... **V. sativa**
Stems angular, a strong climber, stipules large foliaceous 2.5 cm in diameter .... **V. Menziesii**

Vicia Menziesii Sprengel Syst. Veget. 3:267. 1826.
Vicia grandiflora Smith in Rees Cyclop. 37: no. 7. 1819-1820.

A strong climber, nearly glabrous; stems angular, minutely pubescent, very leafy; stipules large foliaceous, pectinately dentate with long and subulate teeth, especially the lower ones which are rounded or flabellate, 12-24 mm in diameter; the upper semisagittate; leaves 15-17.5 cm long; leaflets 8-12, mostly alternate, the lowest near the stem, 3.75-7.5 cm long, 2-2.5 cm wide, ovate-oblong obtuse, mucronulate, very veiny; tendrils compound; peduncles shorter than the leaves, 5-10 cm long, 6-8-flowered, the pedicels slender, about 6-10 mm long; flowers

large 2.5-3.75 cm long, pale purple; calyx 16 mm. the teeth as long as the tube, subulate, the lower one the longest; standard recurved, without a callus; style minutely pubescent above the middle; stigma minute, terminal; pod unknown.

The species is peculiar to the Hawaiian Islands, where it occurs on the largest island, Hawaii, at elevations of from 7000 to 8000 feet. It has only been collected by Menzies, Macrae, and Remy. No botanist since Remy's time has ever again met with this plant. The writer camped several weeks on the high mountains of Hawaii, collecting, but he has never seen it. There is the possibility that the plant has become extinct, as the high elevations on that island are entirely given over to grazing animals, which naturally would make quick work with such a fine leguminous plant. Above 10,000 feet elevation wild cattle and wild horses roam over these mountain tops (Mauna Kea and Hualalai), and thus the plant has undoubtedly become a thing of the past. MacCaughey, who has never seen the plant, speaks of it in his compilations as if it were one of the commonest plants on Hawaii. Not even in the days of Hillebrand, 1860–1870, has the plant been seen again.

Vicia sativa Linn. Spec. Plant. 2:736. 1753.

Vetch.

An annual; stems slender suberect, glabrous or obscurely downy; leaflets 8 to 12, the upper leaves about 2.5 cm long, the lower shorter and broader, stipules small, obliquely lanceolate, deeply toothed; calyx nearly 10 mm. the teeth lanceolate-subulate; flowers solitary or geminate, not racemed, corolla reddish-blue, twice the size of the calyx; pod glabrescent, up to 5 cm long, 8 to 10 seeded.

A native of Europe and the Orient.

Specimens of this species were collected by the writer in the uplands of Hawaii, on the slopes of Mauna Kea at an elevation 5000-6000 feet, in meadow lands and pastures. It was not common, however. The species must have been introduced by the owners of Parker Ranch and the seeds broadcast at the higher levels on Mauna Kea.

This vetch forms an excellent fodder. It has been cultivated from time immemorial; even in the time of Cato was it considered as a splendid fodder.

On Mauna Kea it grew together with *Verbena bonariensis* and *Sophora chrysophylla*, tall species of grasses, etc., which served as its supports.

A number of other species have been introduced by the Hawaiian Sugar Planters' Association, but none of these species are now in cultivation.

PISUM Linnaeus

Calyx campanulate, two-lipped, subequally 5-toothed. Standard broad-ovoid, or orbicular attenuating at the base into a short, broad claw; wings drepaniform-oblong, adhering at the middle to the obtuse incurved keel. Upper stamen free or united with the rest at the middle; filaments somewhat dilated towards the apex. Ovary sessile, many ovuled. Pod compressed, obliquely acute, two-valved. Seeds subglobose. Annual herbs with equally pinnate leaves ending in a branched tendril, the stipules large leaf-like. Flowers conspicuous, purple, red, or white, axillary, solitary, pedicelled.

About six species in Europe and Western Asia. Commonly cultivated throughout the world, *Pisum sativum* Linn.

Pisum sativum Linn. Spec. Plant. 727. 1753.

Common Pea.

An ascending somewhat glaucous, glabrous annual, 0.5 m high or less: leaves alternate, ending in branched tendrils; leaflets 4 or 6, oblong or elliptical-oblong, blunt or apiculate, 1.5-2.5 cm long, the stipules larger than the leaflets, obliquely oblong or ovate up to 3 cm long, base denticulate, rounded and half-clasping the stem; flowers white 1.5-2 cm long; pods inflated 4 to 8 cm long.

The common pea, a native of Europe, grown in these islands from imported seeds for the local market. It is now cultivated in all temperate and in some tropical countries.

ABRUS Linnaeus

Calyx campanulate-cup-shaped, truncate with very short or obsolete teeth. Standard ovate, attenuate at the base, the short broad claw adhering to the staminal tube; wings narrow, elongate to drepaniform, shorter than the curved keel. Upper stamen missing, the remaining nine united into a sheath, split above. Ovary subsessile with many ovules. Style short, incurved with small capitate stigma. Pod linear elongate, usually flat 2-valved, constricted between the seeds. Seeds globose or oblong. Tall climbing shrubs with pari-pinnate leaves; leaflets multijugal, in place of the terminal leaflet a bristle. Flowers small, pink, or white, in terminal or axillary racemes.

About six species cosmopolitan in the tropics. One species (*Abrus precatorius* L.) cultivated in Hawaii.

Abrus precatorius Linn. Syst. Nat. ed. 12. 472. 1767.
Glycine abrus Linn. Spec. Plant. 753. 1753.
Abrus Abrus W. F. Wight in Contr. U. S. Nat. Herb. 9:172. 1905.

Black-eyed Susan.

A slender, feeble, scandent, branched, annual vine, reaching a length of 9 m or less, sparingly pubescent or nearly glabrous; leaves impari-pinnate, the common petiole 8 cm, filiform; leaflets 9 to 11 pairs, oblong, shortly cuspidate-mucronate at the apex, rounded at the base, 18-20 mm long, the lower ones much shorter, 6-8 mm wide; inflorescence an axillary or terminal peniculate raceme usually shorter than the leaves; flowers pink, shortly pedicellate (2 mm), 9 to 11 mm long; standard 9 mm long, broadly oval, obtuse at the apex; wings linear; stamens 9-10 monadelphous; anthers oblong; ovary pubescent, stipitate; pod oblong, 35 mm-50 mm long, about 1.5 cm wide, 3 to 5-seeded; seeds half black, half scarlet, shining 6 mm long.

The *Black-eyed Susan*, as this species is commonly called in Hawaii, is a cosmopolitan of the tropics. It is sparingly cultivated in Hawaii, especially in Honolulu. The seeds are said to be poisonous.

CLITORIA Linnaeus

Calyx tubular, the upper two segments almost united. Standard large, erect, emarginate, attenuate at the base; wings oblong and drepaniform, adhering at the middle to the shorter incurved keel. Upper stamen free or more or less united with the others. Ovary stipitate with several ovules. Style incurved, elongate, horizontally dilated at the apex, bearded. Pod stipitate linear, compressed, ventral and dorsal suture thickened. Seeds globose or ellipsoidal. Herbs or shrubs, usually climbing. Leaves pinnate, 5-7-foliolate; leaflets stipellate. Flowers large, blue, white or red, often two-colored, solitary axillary (or rarely racemose).

About thirty species in the warm regions of both hemispheres with the exception of Europe. Only one species (*Clitoria ternatea* L.) cultivated in Honolulu.

Clitoria ternatea Linn. Spec. Plant. 753. 1753.

A scandent vine, the stems sometimes 1 cm in diam.; leaflets 5 to 7, elliptic to oblong, obtuse 3-7 cm long, the stipellae small, acicular; flowers solitary, the bracts oblong, about 2 mm long, the bracteoles green, roundish 5-8 mm long; calyx green 1.5 cm long, tubular, 18 mm long, tube 11 mm, membranous, the lobes ovate, acute, mucronate, reticulately veined; standard obovate attenuate at the base, deep blue usually with a white center, 4.5 cm long, 3.5 cm broad; wings long-clawed, 2 cm long, 1 cm broad; keel deeply concave, sacciform; stamens diadelphous; anthers elliptical; ovary pubescent; style pubescent to the apex; pod 10 cm long, 7 cm wide, flat, puberulous, 5-10-seeded; seeds reniform, compressed, 6 mm long, 5 mm wide.

Clitoria ternatea is a cosmopolitan in the tropics and is widely cultivated on account of its large deep blue flowers. It is not uncommonly found cultivated in Hawaii. It is becoming naturalized and has already been found as an escape from gardens in various waste places. It is a prolific seeder. The specific name refers to the Island of *Ternate*.

GLYCINE Linnaeus

Calyx more or less campanulate, upper two segments united only at the base or beyond the middle. Petals very unequal. Standard orbicular or obovate, attenuate at the base, slightly auriculate; wings oblique and narrow, adhering to the shorter or very short obtuse keel. Stamens all united or the upper stamens free. Ovary subsessile, with two to many ovules; style usually short, slightly incurved, with terminal capitate stigma. Pod linear or drepaniform, rarely broad, compressed or terete, 2-valved, constricted between the seeds. Tall climbing or prostrate rarely erect herbs with pinnate leaves; leaflets three, sometimes 5 or 7, with stipellae. Flowers small, purplish red or bright pink, in axillary racemes, single or fascicled along the rhachis.

About fifteen species in tropical Africa, Asia, and Australia.

Most cultivated species is *Glycine max* (Linn.) Merrill.

Glycine max (Linn.) Merrill in Interpr. Rumph. Herb. Amb. 274. 1917.
Phaseolus max Linn. Spec. Plant. 725. 1753.
Soja hispida Moench. Meth. 153. 1794.
Glycine hispida Maxim in Bull. Acad. Petrsb. 18:398. 1873.
Glycine soja S. & Z. in Abh. Akad. Muench. 4²:119. 1843.

Soy Bean.

An annual herb, 25-50 cm long, stems stout suberect or climbing upwards, densely clothed with fine ferruginous hairs; leaves long-petioled, leaflets 3, membranous, ovate acute, rarely obtuse, 5-10 cm long; racemes few-flowered, congested sessile; calyx 6 mm, the teeth long setaceous, densely hairy; corolla reddish, little exserted; pods usually only 2 to 3 developed in the axil of each leaf, linear-oblong, recurved, densely pubescent, up to 5 cm long, 8 to 10 mm wide, 3 to 4-seeded, subtorulose.

The common Soy bean, a native of India and eastern Asia, but now widely cultivated.

The Soy bean has been cultivated in China and Japan from the very remotest times; its cultivation is estimated to date back more than 5000 years. It was introduced into England in 1790 and into Italy in 1848.

The seeds of the Soy bean vary greatly in color, yellow, red, brown, black, green, or variegated. The root nodules are of fairly noticeable size and contain millions of bacteria. More than 400 varieties of Soy beans are in existence and they seem to be nearly all classified according to the color of the seed.

The yield of green manure is inferior to that of the cow pea or black pea (*Vigna catjang*). It is particularly resistant to drought and gives satisfa tory results where the yield of the cow pea would only be small.

Much has been written about the Soy bean and its cultivation; special mention may be made of P. de Sornay's "*Green Manures and Manuring in the Tropics*," 1916, where concise records are given as to cultivation, yield, etc.

ERYTHRINA Linnaeus

Trees with prickly branches. Flowers large, coral red, carmine or *scarlet,* in dense racemes or axillary, produced usually before the development of the constantly 3-foliolate leaves. Calyx oblique, spathaceous, tubular, campanulate-bilabiate or truncate and obsoletely toothed. Petals very unequal; standard always much exserted and considerably exceeding the keel and wings. Upper stamen free down nearly to the base or connate with the others half way up the filaments; anthers uniform. Ovary stalked, many-ovuled; style incurved, beardless, stigma capitate. Pod torulose, turgid, linear or moniliform. Seeds bright red, carmine, or brown.

The genus consists of about thirty or more species, distributed over the tropics of both hemispheres. About fourteen species are in cultivation in Hawaii; one species is indigenous.

Besides the species of *Erythrina* treated more fully in this paper, there are

PLATE 72.

ERYTHRINA ABYSSINICA Lam.

still a few others in cultivation at the College of Hawaii arboretum; their identity is, however, doubtful, as they have as yet not flowered.

Seeds were received under the name *E. umbrosa* and quite a formidable tree has developed, but has as yet not flowered. Seeds of two species were received from Southern California, one as *E. crista galli*, which had, however, nothing to do with that species; the plants are different from any cultivated in the islands. One species was introduced by Gerrit P. Wilder; it proved to be *E. caffra*, an African species.

KEY TO THE SPECIES.

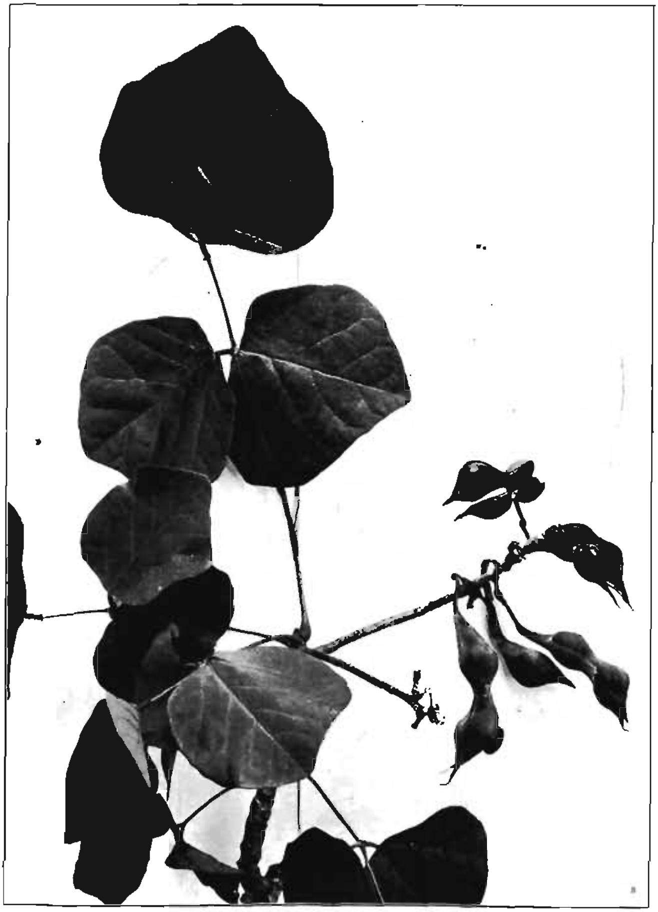
Pods moniliform. (African species.)
  Calyx obliquely labiate, obsoletely denticulate .... **E. caffra**
  Calyx spathaceous, its lobes long, whip-like .... **E. abyssinica**
Pods turgid or torulose. (Asiatic-Polynesian species.)
  Pods seed-bearing throughout their length, the basal portion not flattened.
    Calyx spathaceous oblique splitting to the base down the back, or tubular and splitting laterally.
      Calyx splitting to the base down the back, spathaceous, glabrous, as are the pod and leaves.
        Leaves broadly rhomboidal, truncate at the base .... **E. indica**
        Leaves deltoid coriaceous cuneate at the base, marked with yellow stripes along midrib .... **E. Parcelli**
      Calyx splitting laterally, at first tubular, minutely 5-toothed, tomentose as are the pod and leaves .... **E. monosperma**
      Calyx campanulate subequally 2-lipped not splitting to the base, or truncate and obsoletely toothed.
          Leaflets twice as long as broad .... **E. fusca**
          Leaflets as broad as long .... **E. arborescens**
        Calyx subequally 2-lipped.
      Calyx truncate, campanulate or cylindrical. (American species.)
        Standard broadly ovate, dark carmine .... **E. cristagalli**
        Standard linear oblong.
          Leaflets entire, a tree .... **E. coraliodendron**
          Leaflets sinuately 3-lobed, a shrub .... **E. arborea**
Pods flat seedless and indehiscent in their lower half. (Asiatic-Malayan.)
  Calyx velvety splitting to near the base into two lips .... **E. subumbrans**

Erythrina caffra Thunb. Fl. Cap. 559. 1807.

A tree 10-20 m high, branches prickly, petioles unarmed; bark of the twigs pallid, rugose; prickles small; leaves clustered toward the end of the twigs on puberulous petioles of 5-10 cm; leaflets petiolate, broadly ovate, 5-6.5 cm long, 3.5-5 cm wide, rounded at the side, suddenly tapering to a blunt point, thin, membranous, glabrous; racemes densely many-flowered, peduncles 10-15 cm long; flowers scarlet; calyx tomentulose, obliquely labiate or splitting, afterwards enlarged, obsoletely denticulate; vexillum minutely velvety, falcate-oblong, up to 5 cm long; vexillary stamen adnate below the middle to the split stamiual tube; legumes moniliform glabrate, unarmed.

Erythrina caffra is a native of South Africa, Port Natal, where it occurs in woods not far from the sea. The species is cultivated in Southern California, whence the writer brought a living specimen to Honolulu. It has been planted out at the College campus, where it flowered for the first time in January, 1919. The bright scarlet flowers make this tree an object of great beauty.

PLATE 73.



ERYTHRINA MONOSPERMA Gaud.
Wiliwili.

Erythrina abyssinica Lamarck Encycl. 2:392. 1785.
Erythrina latissima E. Meyer Comment. 151. 1835-1837.
Erythrina tomentosa R. Br. in Salt. abyss. App. 63. 1814. Name only.

Plate 72.

A tree 3-7 m high with woody spinose branches densely clothed with fine gray tomentum; stipules lanceolate 6 mm to 10 mm long; petiole 10-15 cm long, densely gray tomentose, spinose; leaflets roundish or broad-ovate thickly subcoriaceous, densely tomentose on both sides, terminal one 10-15 cm in diam.; broader than deep, blunt at the apex, rounded or cordate at the base, petiolule 5-7.5 cm long; spike erect, ovoid, densely many-flowered, 5-10 cm long, on woody peduncles of 15-20 cm long; pedicels 4-6 mm very woolly; calyx 2.5 cm to 3 cm long, tomentose on the back, slit down to nearly the base on the underside, cut more than a third down on the upper side into five whip-like laciniae; corolla bright scarlet, the standard longer than the calyx or as long, 12 mm long, wings about 10 mm long, keel shorter; pod 10-12.5 cm, subligneous, consisting of about six close 1-seeded globes 14-16 mm thick, stalked at the base; seeds small scarlet.

Erythrina abyssinica is a native of tropical Africa and of the Cape Colony, distributed through the Nile Land and the Mozambique District, Zambesi Land, Port Natal, and the Table Mountain.

It was first introduced by Mr. Alexander from the Victoria Nyanza region, the first tree having been planted in Hilo.

There are two specimens flowering and fruiting on Makiki Square. Specimens have been grown from seed from the Hilo tree and have been planted at the College Arboretum.

It is a very curious *Erythrina* and quite different from any of the other species cultivated in the islands.

Erythrina monosperma Gaud. Bot. Voy. Uranie. 486, pl. 114. 1826.
Erythrina montana Forst. in Pancher, Herb., et in Cuzent, Tahiti, 240. 1860.
Erythrina tahitensis Nadeaud Enum. no. 499. 1873.
Corallodendron monospermum O. Ktze. Rev. Gen. Plant. 1:173. 1891.

Wiliwili.

Plates 73, 74.

A tree 6-10 m high, sparsely aculeate with short conical prickles; trunk short or occasionally 5 m long and vested in a thin yellowish bark with longitudinal ridges; crown broad spreading, with glabrous, stiff, gnarled branches, fulvo-tomentose at their ends; leaflets ovate-deltoid, broader than long, 5-6.5 cm long, 6.5-9 cm wide, obtuse, entire, truncate to subcordate at the base, chartaceous, tomentulous beneath; the petiole 8.5-25 cm long, extending considerably beyond the lateral leaflets, petiolule of the terminal leaflet about 1 cm, that of the lateral ones about 5 mm and articulate; stipules gland-like, one or two for the base of the petiole, one for each lateral and two for the terminal petiolule; racemes in the axils of the ultimate leaves, fulvo-tomentose, stout when with fruit, but often slender when with flower, nodose in the upper third, with one or two or three flowers at each node, 8-15 cm long; bracts triangular, 2 mm or less; pedicels 4-8 mm with flower, 10-12 mm with fruit; calyx thickly tomentose tubular-spathaceous, minutely toothed, 15 mm or more long; standard 2.5 cm in diameter (up to 5 cm teste Hillbr.), scarcely stipitate; wings oblong obtuse 12

PLATE 74.

ERYTHRINA MONOSPERMA Gaud.
A Wiliwili Tree at North Kona (lava flows), near Puuwaawaa, Hawaii.

[From J. F. Rock: "The Indigenous Trees of Hawaii" (Copyrighted).]

mm (up to 18 mm teste Hillebr.); keel 10-16 mm, its two petals free; stamen as long as the standard, the alternate ones shorter, that opposite the standar connate at the base; anthers pointed versatile; ovary tomentose, stipitate, thre to five-ovuled, narrowing to a slender straight or curved style 15-20 mm long pod torulose, pubescent acuminate at both ends, coriaceous-ligneous, dehiscen 1- several-seeded; seeds scarlet or darker red, 15 mm long, hilum elliptical mm; flowers brick red, orange or pale yellow.

KAUAI: *Makaweli gulch, fruiting* March 3-10, 1909, Rock no. 2156 i herbarium College of Hawaii.

OAHU: Koko Head, Rock no. 5839 in herbarium College of Hawaii.

MOLOKAI: Mahana, west end, fruiting March, 1910, Rock, in herbariun College of Hawaii.

MAUI: *Auahi-Kahikinui, southern slopes of* Haleakala, Rock, in herbariu College of Hawaii.

LANAI: Mauna Lei; flowering and fruiting July 13, 1910, Rock no. 8118 i herbarium College of Hawaii.

HAWAII: Puuwaawaa, N. Kona, Rock in herbarium College of Hawaii;— observed at Kapua, S. Kona, Naalehu, Hilea, Kau, etc.

KAHOOLAWE: Observed by R. S. Hosmer.

Specimens with pale yellow flowers were observed both on Lanai and Hawaii

The native name of this tree is Wiliwili.

E. monosperma inhabits the dry regions on all the islands of the archi pelago. It occurs from about 500 feet elevation to 2000 feet, but rarely higher It loves the hot arid lava flows, and is always found on the leeward side and never on the windward side of the islands. On Kauai it may be found in Waime Canyon, the rocky slopes back of Kekaha and Waimea, and also on the drie part of the Haupu range. On Oahu it is common in the valleys of the Waiana range, as at Mokuleia, etc, also on the extreme eastern end of the Koolau range at Wailupe, Niu and Koko Head. On Molokai it occurs back of Kaunakakai and must have been very common all over the western end of the island, where it still occurs in clumps or as isolated individuals in dry canyons. It is associated with *Reynoldsia sandwicensis, Gardenia Brighami, Plectronia odorata. Xylosma Hillebrandii, Kokia drynarioides, Osmanthus sandwicensis, Breweria Menziesii, Maba sandwicensis, Chrysophyllum polynesicum,* and *Nototrichium sandwicense.* On Maui it is not uncommon back of Makawao and especially s on the southern slopes of Haleakala at Auahi and Kahikinui, where it grows with some of the species above mentioned and *Rauwolfia sandwicensis,* species of *Pittosporum, Alectryon macrococcus, Pelea Knudsenii* var. *multiflora* and others. On Lanai it can still be found on the slopes back of Manele, as well as in the deep and arid gorges of Mauna Lei and Nahoku, also in the desert region of Kaa. On Hawaii it is still most numerous, especially on the lava flows of both North and South Kona and Kau. It forms practically a belt around that part of the island, beginning at Hilea, through Manuka, Kapua, Honomalino, Papaa, Kealakekua, Huehue, Puuwaawaa to Puuanahulu, Kawaihae-uka, and Puukawai near Wai-

PLATE 75.

ERYTHRINA INDICA Lam.
Tiger's Claw or Coral Tree.

[From J. F. Rock: "The Ornamental Trees of Hawaii" (Copyrighted).]

mea. Its associates in Kona are *Mezoneurum Kauaiense*, *Dracaena aurea*, *Charpentiera obovata* var., *Alphitonia excelsa*, *Colubrina oppositifolia*, *Kokia Rockii*, *Sideroxylon auahiense* var. *aurantium*, *Pittosporum Hosmeri* and its variety *longifolium*. In the Kona district it develops huge trunks of several feet in diameter, which are of a dirty orange yellow; the flowers are either red, brick red, yellowish or white. The trees are often festooned with *Canavalia galata* var. *pubescens*. Even the island of Kahoolawe still supports a few trees of this species, about the only native tree in existence there.

It is on the Islands of Kauai, Molokai, and especially Oahu that the tree is on the verge of extinction, while on Hawaii it is still abundant, owing to the uselessness of the land on which it grows, being mainly found on rough aa lava flows inaccessible to cattle, the arch enemy of Hawaiian trees and forests in general.

The wood of the Wiliwili is soft and very light, and was used by the Hawaiians for the float in the outrigger of their dug-out canoes.

Erythrina indica Lam. Encycl. 2:391. 1785.

Coral Tree or *Tiger's Claw.*

Plate 75.

A tree sometimes reaching 20 m in height; bark thin, gray, the prickles small or minute, black or brownish-black; leaves 20-30 cm long, trifoliolate; petioles 10-15 cm, without spines, leaflets of a brilliant green, puberulous or glabrous, the terminal broader than long, 10-15 cm long, round-cuspidate at the apex, truncate or broad rhomboidal at the base, petiolules 7.5-10 mm, stipellae in the form of a gland, persistent, stipules lanceolate, 10 m long; racemes 15 cm long, dense, on spreading woody peduncles, 7-10 cm long; pedicels 6 mm, bibracteolate at the apex, bracts small, triangular, caducous; calyx 2.5-3 cm long, with a very oblique mouth from the first (spathaceous), subglabrous, minutely 5-toothed at the apex; corolla deep red; standard 5-6 cm long, 2.5 cm wide, wings and keel subequal, not more than half as long as the calyx; pod up to 3 dm long, distinctly torulose, black, glabrous, late dehiscent, 6-8 seeded, the seeds dark-carmine, reniform, 15 mm long, 10 mm wide.

Erythrina indica is a very widely distributed tree, occurring naturally all through India from the foot of the Himalayas to Ceylon, Burma, Malay Islands, Java to Polynesia. In Hawaii it is not native, but cultivated only. Great confusion exists in regard to the synonymy of this species.

Rumphius named the species in question *Gelala litorea*, which was reduced by Linnaeus to *Erythrina corallodendron*. Under this latter name Linnaeus placed an American species and what is known as *E. indica*. In the second edition of the Species plantarum he reduced Rumphius' *Gelala litorea* = *E. indica* to a var. *orientalis* of *E. corallodendron*, while the latter name apparently typifies the American plant.

A form with variegated leaves was named by Rumphius *Gelala alba*, which formed the basis for Linnaeus' *Erythrina variegata* L. and in part the basis of *E. picta* L. Merrill suggests that the specific name *variegata* should be adopted, and it should include not only the variegated form, but also what is known as

PLATE 76.

ERYTHRINA PARCELLI Hort.

E. indica. He accepts, however, Linnaeus' variety *orientalis* of *E. corallodendron* for *E. indica* and reduces that species to: *Erythrina variegata* L. var. *orientalis* (L.) Merrill. The specific name *indica* is, however, so well known and has been used in all Floras published up to now that it seems advisable to maintain that name.

In India it is known under the common name of Indian Coral-Tree.

It is a fairly quick growing tree and is often planted on account of its handsome red flowers, which appear in January-February.

The bark is said to yield an excellent cordage fibre of a pale straw color.

The bark is used medicinally by the East Indians as a febrifuge; it is also antibilious.

The juice of the leaves is considered a good vermifuge and cathartic. They are also used as fodder for cattle. Besides being planted as an ornament, it is also planted to support and shelter the betel and black pepper vine. In Honolulu the tree is quite commonly planted; it is about the first tree to burst into flower, usually during the month of January.

Erythrina Parcelli Hort. Bull. in Gard. Chron. 2:392, f. 82. 1874.

Plate 76.

A medium sized tree 5-7 m high, sparingly aculeate, with ascending branches; petioles unarmed, terete, glabrous up to 15 cm long to the terminal leaflet; petiolules 8 mm, stipellae gland-like, orbicular; leaflets ovate-deltoid, subcordate at the base but cuneate, the lateral ones longer than broad, inequilateral, and smaller than the terminal one, triplinerved, terminal leaflet broadly deltoid, acute or obtuse at the apex, dark green above and below, with stout midrib and veins, projecting below, up to 12 cm long, up to 10 cm wide, glabrous, and subcoriaceous, often yellowish-marked along the midribs in younger leaves; racemes large horizontally spreading as in *E. indica;* flowers coral-red; calyx spathaceous but not cut to the base on the back, irregularly toothed at the apex, the calycine tube bibracteolate above the middle with two subulate bracteoles 8-10 mm long; standard ovate-elliptical, acute at the apex, gradually narrowing at the base, 6.5 cm long, nearly 3 cm wide; wings free from the keel, of a darker red, broadly obovate, cuneate at the base, 24 mm long, 10-12 mm broad at the apex; keel petals free longer but narrower than the wings, glossy inside; stamens diadelphous, the vexillary stamen free to the base, the others alternating in size, one long, one short, nearly as long as the standard; ovary long stipitate densely covered with a dark gray glandular tomentum; style long, exceeding the stamens, glabrous in the upper portion.

This species, supposedly a native of the Pacific islands, was introduced into these islands by the late Governor Cleghorn. The writer knows of only one tree in the whole Territory. It is to be found on the grounds of the home of President Griffith of Punahou College, Honolulu.

The tree flowers profusely but does not produce seeds; it can be cultivated, however, from cuttings. A species worthy of cultivation on account of the variegated leaves and the large racemes and large fire-red flowers.

Some authors regard *E. Parcelli* as a variety of *Erythrina indica*, but if the plant cultivated in Hawaii is really identical with *E. Parcelli*, then certainly it

PLATE 77.

ERYTHRINA FUSCA var. inermis Rock

cannot be classed as a variety of *E. indica.* The leaves are distinctly deltoid and cuneate at the base; the flowers are flame-red with a very velutinous ovary. The branches are not subhorizontal as in *E. indica,* but straight ascending.

Erythrina fusca Lour. Flore Cochinch. 427. 1790.
Erythrina ovalifolia Roxb. Hort. Beng. 53. 1814.

A tree reaching a height of 10 m, the trunk with large, conical protuberances, the branchlets and sometimes the petioles with small scattered prickles; leaves 20 to 30 cm long, petiole 10 to 12 cm long, slightly pubescent, later glabrous; leaflets three, coriaceous, glabrous, rounded or obtuse at the base, obtuse or acute at the apex, terminal one ovate, 8-15 cm long, lateral ones ovate-oblong or elliptical, smaller; stipellae converted to persistent round glands; stipules membranous, caducous, orbicular, 3 mm in diam. Raceme 7.5-20 cm long, bracts broadly oval, puberulous, caducous, pedicels puberulous, bibracteolate at the apex, 7-15 mm long; flowers 18-20, distant; calyx 12 mm long, 15 mm wide, pubescent, two-lipped, the lobes obtuse, petals finely pubescent, dull purplish-red, standard cuneiform, about 4 cm long, wings about 20 mm, keel little longer; pistil grayish-pubescent; pod 15-20 cm long, subcylindrical about 1.5 cm wide, 6-11 seeded; seeds 12 mm long, reniform, brown or mottled.

Erythrina fusca is widely distributed through the Malayan region, being found in Java, throughout the Philippines, Siam, Cochin-China, India, and Polynesia.

The writer brought seeds of this species from Manila; they came from a tree growing on the corner of Calle Herran, near the Bureau of Science. Young plants grown from this seed were set out at the College grounds, and other seedlings were distributed to parties interested in plants. They have as yet not flowered. The young plants are exceedingly spiny, possessing stout, black, conical thorns. One large tree is in cultivation on Anapuni Street, which is entirely spineless, the flowers are not reddish-purple, but are yellowish-flesh-colored, the racemes are drooping; the tree flowers when in full foliage. It is certainly quite different in appearance from the true *E. fusca,* as even the seedlings do not show a single spine. The leaves are, however, the same as those of *E. fusca.* I would propose the varietal name *inermis* for the plant in question. **(Plate 77.)**

A smaller tree may be found on Pensacola Street in the grounds of the Davenport Hotel. From the bark of *Erythrina fusca* a decoction is made which is employed in treating intermittent fever. The leaves, after being bruised, are also used medicinally for cleansing putrid ulcers.

Unlike other species of *Erythrina, E. fusca* loves the borders of pools and morasses, which caused Rumphius to name it *Gelala aquatica.*

A species worthy of cultivation.

Erythrina arborescens Roxb. Hort. Beng. 53. 1814.

A low tree with few prickles on the branches (18-20 feet), 6-7 m high, trunk cylindrical; branches cylindrical, spines larger at the base; leaves trifoliolate, the common petiole 20 cm; leaflets large, triangular 13-25 cm long, 10-15 cm

PLATE 78.

ERYTHRINA CRISTAGALLI Linn.

broad or even more, greenish on both sides with red midribs; stipellae gland-like; stipules small ovate; inflorescence a solitary panicle, horizontal 12-15 cm long including the peduncle, tomentose; flowers about thirty, brick-red, densely grouped; pedicels 1 cm, articulate at the apex near the calyx, bibracteolate at the base; calyx 1 cm, pubescent, deeply two-lipped; standard oblong, obtuse at the apex, 3 cm long, 1 cm wide, wings small, 5 mm, very obtuse, keel yellowish-white, 15 mm long, oblong; stamens 10, monadelphous; the pediculate pistil *very tomentose; ovules 8-10; pod much curved, 15-20 cm long, 15-25 mm wide;* seeds 5-10, oblong, reniform, reddish, 15 mm long, 10 mm wide.

Erythrina arborescens is a native of Northern India, where it inhabits the mountains of the Central and Eastern Himalayas, as Kumaon, Sikkim, and the Khasia hills, ascending to 7000 feet.

The species was introduced by the writer from Darjeeling, and specimens have been planted out on the College of Hawaii campus, where it has already flowered. It would be a good addition as an upland forest tree, notwithstanding its small size. The wood of this species is compact, less spongy, and has more numerous concentric bands of soft texture than *E. indica*.

Erythrina cristagalli Linn. Mant. Plant. 99. 1767.

Plate 78.

A tree 10 m or more, trunk aculeate, wood soft; leaves deciduous; petioles 7.5-15 cm long, armed or unarmed, or extending along the costa of the leaflets; leaflets 5-10 cm long, 2.5-5 cm wide, ovate to ovate-lanceolate, acute at the apex or acuminate or slightly obtuse, the base rounded or cuneate, rigidly membranous or subcoriaceous, green on both sides or glaucous underneath; pedicels axillary up to 2.5 cm long, fasciculate in two or fours in the upper axils; flowers dark carmine; calyx 8-12 mm long, broadly campanulate truncate or subbilabiate, *the inferior lobe very shortly mucronate; standard 3.75 cm long, recurved,* broadly ovate, shortly clawed, narrowing at the base; wings oblong 6-8 mm long; keel lanceolate falcate 2.5 cm long, very shortly clawed or subsessile; ovary villous-tomentose; style glabrous; pod stipitate 15 cm or more long, 12-16 mm wide, slightly falcate, turgid, glabrous, seeds several transverse oblong, with an oblong hilum, brownish-gray in color.

Erythrina cristagalli, the cock's comb.

It is a native of tropical America, especially Brazil, but is widely cultivated as a pot plant on account of its very showy flowers. Several plants occur in Honolulu, but the species has not been planted plentifully. A specimen on the College of Hawaii *campus has flowered and fruited three times a year.*

Erythrina corallodendron Linn. Spec. Plant. 2:706. 1753.

Plate 79.

A tree 5-7 m high, trunk with few thick (stout) spines; petiole naked or rarely armed; leaflets 7.5-10 cm or larger, acuminate or obtuse, broadly ovate-rhomboid, thin, membranous when dry, subtruncate at the base; racemes axillary short or 3 dm or more long, young racemes covered with a removable pubescence; flowers on short pedicels; calyx 8-12 mm long, obliquely truncate, rarely very shortly bilabiate, with 3 minute inferior teeth, or all obsolete; vexillum 5-6.5 cm long, slightly falcate, narrowing at the base into a very short claw; wings

PLATE 79.

ERYTHRINA CORALLODENDRON Linn.

obovate-oblong, slightly exceeding the calyx; keel little shorter, often shortly acuminate at the apex; stamens little shorter than the standard, vexillary stamen connate at the base with the others; pod stipitate, glabrous many seeded, torulose between the seeds; seeds scarlet about 12 mm long, reniform.

Erythrina corallodendron L. was originally a mixture of *E. corallodendron* and *E. indica*, the two having been considered apparently identical by Linnaeus. *E. corallodendron* is, however, typified by the American plant. It is a native of tropical America and the West Indies, occurring in Brazil, Mexico, the Bahamas, Martinique, Cuba, Jamaica, Puerto Rico, etc.

In Hawaii, a few plants are cultivated on Pacific Heights, Honolulu, where they flower and fruit freely. Plants have been raised of this species and planted on the College of Hawaii grounds; they seem not to like the dry hot climate.

On account of the size of its flowers it is quite a noticeable tree, and should be more commonly cultivated.

The wood is soft, corky, and is known as coral wood in the West Indies; it is manufactured into corks, light ladders, etc. Rochefontaine and Rey extracted an alkaloid from the bark of the stem, which acts upon the central nervous system without affecting the motor nerves and muscular contractility. The isolated alkaloid is known as Erythrocoralloidin. In South America the bark is used generally as a narcotic and sedative.

Erythrina arborea Small Fl. Southeast U. S. 647. 1903.

A shrub, with ascending branches from a common root-stock; leaves deciduous before anthesis; petioles sparingly armed or unarmed 3-6 cm long, glabrous, leaflets deltoid, shallowly 3-lobed, broadly cuneate at the base, acute or obtuse at the apex, racemes red of the same color as the flowers the latter of a brighter color; pedicels 5-6 mm; calyx truncate, 8-9 mm long, cylindrical, very inconspicuously toothed, red; standard oblong, 3.2 cm long 9-10 mm wide, emarginate at the apex, not clawed at the base; wings not protruding from the calyx, keel 10 mm long united, emarginate at the apex; stamens 10, 9 united the vexillary stamen free, all shorter than the standard and all of unequal size; ovary green, silky pubescent; pod 3-8-seeded, chartaceous, glabrous, falcate, stipitate, torulose between the seeds; seeds scarlet, of the size of E. corallodendron.

This small species is a native of Mexico and Florida. Specimens were grown by the writer from imported seed; there are several plants flowering and fruiting at the College or Hawaii campus, on the rockery back of the main building. A handsome species and worthy of cultivation on account of its numerous racemes with bright red flowers and bright green foliage. *Erythrina herbacea* Linn. was lately introduced by Dr. H. L. Lyon. *E. arborea* Small differs very little from *E. herbacea*, save in the shrubby habit and the shorter flowering racemes.

STRONGYLODON LUCIDUS Seem.
Nuku-iwi.

Erythrina subumbrans (Hassk.) Merrill in Philip. Journ. Sc. 5, n. 2:113. 1910.

Hypaphorus subumbrans Hassk. Retzia ed. nov. 198, fide Koord. & Val. Hort. Bog. Descr. 197. 1858.

Erythrina lithosperma Miqu. Fl. Ind. Bat. 1:209. 1855. (Not Blume.)

A tree reaching a height of 15 m, unarmed, or with few prickles; leaflets ovate acuminate, base rounded or subacute, 7-14 cm long; petioles 10-12 cm long, leaflets membranous, at first pubescent, later perfectly glabrous; racemes pubescent, in the upper axils, about 10 cm long; calyx pubescent about 8 mm long, 2-lipped; petals red, standard 35 mm long, obtuse, oblong, the keel and wings subequal about 20 mm; stamens 10, monadelphous or the superior free to near the base; pod flat, 10-20 cm long, 25-30 mm wide, indehiscent, and seedless in the lower one-half, bearing 1-3 seeds at the tip, with an elongated slender stalk.

Erythrina subumbrans is widely distributed through the Malay Archipelago, as the Philippines, Burma, Indo-China, Java, etc.

Specimens have been introduced by the writer from Java, and also recently by the Board of Agriculture and Forestry from the Philippines. Specimens are growing on the College of Hawaii campus.

In East Java the tree grows up to an elevation of 4500 feet; it loves sandy, rocky regions with little rainfall. It is a quick grower, reaching an age of forty to fifty years. It is planted mainly as a shade tree on coffee plantations, and should prove to be a fine tree for the coasts of Kona on Hawaii.

STRONGYLODON Vogel

Calyx campanulate with obtuse broad teeth, of which the upper two are slightly united. Standard recurved, ovate-oblong, with two appendages on the inner side above the claw; wings much shorter than the standard, adhering to the keel; the latter much incurved, beaked, as long as the standard, petals united. Upper stamen free. Ovary stipitate, surrounded at the base by a dentate discus, with one or two ovules. Style filiform, with terminal somewhat capitate stigma. Pod stipitate, obliquely ovate-oblong, 2-valved. Seeds thick, orbicular, half surrounded by the linear hilum. Glabrous, winding shrubs with trifoliolate leaves, usually with stipellae. Flowers large red, in axillary elongate racemes.

Five species are known in Oceanea, Ceylon, and Madagascar.

Strongylodon lucidus Vogel is the only indigenous species in the islands.

Strongylodon lucidus Seem. Flora. Vitiensis 61. 1865.

Glycine lucida George Forster Florulae insul. austral. Prodromus no. 379. 1786; et Icon. pl. 197 (ined. cf. Seem.)

Rhynchosia lucida DC. Prodr. 2:387. 1825.

Strongylodon ruber Vogel in Linnaea 10:585. 1836.

Mucuna altissima Hook. et Arn. Bot. Capt. Beechy's Voy. 81. 1841.

Harpoctropis speciosus Nuttal in Herb. Hooker.

Nukuiwi.

Plate 80.

A tall woody climber with herbaceous branches, glabrous throughout; leaflets membranous (chartaceous when dry) ovate to oblong-ovate 6.5-12.5 cm long,

PLATE 81.

MUCUNA ATERRIMA (Piper et Tracy) Merrill
Florida Velvet-bean.

5-7.5 cm wide, on petioles of 4-8 mm, triplinerved, acuminate, glossy, the two lower ones uneven-sided, the linear stipellae half as long as the petiolules: racemes drooping slender, 25 cm-45 cm long: flowers bright scarlet, generally in fascicles of three, on short elongate nodes, the slender pedicels about 2.5 cm; calyx campanulate, the two upper teeth connate; standard reflexed oblong, obtuse, keel incurved, falcate, the wings one-third the length of the keel, rounded: ovary glabrous, ovules one to two; pod chartaceous, obliquely ovoid, complanate, 10 cm long, 5.5 cm wide; seeds one, rarely two, black.

The *Nukuiwi* is a native of the Hawaiian Islands, but occurs also in Tahiti, Fiji, in Ceylon, where it is rather rare in the low country in intermediate regions. It has recently been discovered also in the S. Andaman Islands in the Indian Ocean.

Elmer D. Merrill collected it on the Island of Balut in the Philippines, and he states that it has been found also in New Guinea.

In Hawaii it occurs on all the islands, especially in the lowlands up to an elevation of 2500 feet. It is found in the rain forests, covering trees and bushes, on the lee as well as windward sides. It is quite common along the volcano road up to Glenwood; on Oahu it occurs in all the valleys and also on Kaala. The native name, *Nukuiwi*, refers to the bill (*nuku*) of the red bird *Iiwi*.

MUCUNA Adanson

Calyx cup-shaped with very unequal teeth, the two upper entirely united, the lower longer than the middle ones. Standard folded shorter than the oblong or ovoid incurved wings; keel as long or longer than the wings, beaked, and biauriculate at the base. Upper stamen free; five stamens with longer and subbasifixed anthers alternating with five shorter and dorsifixed and often bearded anthers. Ovary sessile with few ovules. Style slender with small, terminal stigma. Pod thick, ovoid to oblong, or linear, smooth or transversely ridged, keeled along the sutures or not, softly pubescent, glabrous or often covered with irritating, brown hairs. Tall climbing, rarely erect shrubs or herbs with trifoliolate leaves, and stipellae. Flowers large deep purple, red or yellowish-green, in axillary racemes.

About thirty species in the warmer regions of both hemispheres. Two species occur naturally in the islands; the others have been imported and are under cultivation.

KEY TO THE SPECIES.

Flowers purple.
- Seeds black shining, pods dehiscing at maturity .... **M. aterrima**
- Seeds white, with gray or black spots, pod indehiscent .... **M. pachylobia**

Flowers green or bright yellow with red.
- Flowers green, pod smooth, glabrate .... **M. gigantea**
- Flowers bright yellow with red, pod with transverse tamellae, hirsute .... **M. urens**

Various species of *Mucuna* have been introduced by Dr. H. L. Lyon, who grew them at the Hawaiian Sugar Planters' Experiment Station.

PLATE 82.

MUCUNA GIGANTEA (Willd.) DC.

Kaeee.

Some of the species introduced have been discontinued from cultivation and practically none of the introduced ones are naturalized or growing wild at the present. *Mucuna pachylobia* and *Mucuna aterrima* may have escaped and there is a likelihood of their being found wild in the future.

The species introduced were *Mucuna pruriens* (Linn.) DC., *Mucuna hassjoo* (Piper & Tracy) Rock, *Mucuna velutina* Hassk. and probably also *Mucuna nivea* (Roxb.) Wight & Arn. and *Mucuna deeringianum* (Bort.) Merrill.

Mucuna gigantea and *Mucuna urens* are indigenous in the islands, but of course occur elsewhere.

Mucuna aterrima (Piper & Tracy) Merrill in Interpr. Rumph. Herb. Amb. 279. 1917.

Stizolobium aterrimum Piper & Tracy in U. S. Dep't. Agr. Bur. Pl. Ind. Bull. 179:18, t. 4, f. B, t. 7. 1910.

Cacara nigra Rumph. Amb. 5:381, t. 138. 1847.

Florida Velvet-bean.

Plate 81.

A vigorous and strong vine, the stem striate but scarcely furrowed, covered with a soft, sparse pubescence; leaflets very large, plane, mostly acute, strongly mucronate, sparsely appressed-pubescent on each side; racemes pendent, 45 to 75 cm long, many-flowered; flowers purple; calyx not saccate, densely appressed-pubescent without and within; pods falcate about 10 cm long, black when mature, sparsely covered with a short, white appressed pubescence, median ridge on valves prominent, but sometimes broken, secondary ridge faint or wanting; seeds 4 or 5, oblong, black, very shiny, 10-12 mm long, the prominent hilum white

This species was described from cultivated specimens, the seeds having originated from plants of various geographical regions, as Brazil, Australia, Mauritius, Java, Ceylon, etc. Merrill points out that the species in question is identical with Rumphius' *Cacara nigra* and possibly *Cacara pilosa*.

In Hawaii the species is cultivated under the name of Mauritius bean; it is also known as the Florida Velvet bean.

Mucuna pachylobia (Piper & Tracy) Rock, comb. nov.

Stizolobium pachylobium Piper & Tracy in U. S. Dep't. Agri. Bur. Pl. Ind. Bull. 179:19, t. 5, A, t. 6. 1910.

Fleshy-pod Bean.

Vines stout, 15-20 m long; stems sparsely pubescent with soft white hairs, leaflets 7.5 cm to 17.5 cm long, mostly acute, cuspidate, sparsely appressed-puberulent on both sides, especially on the veins beneath; racemes 3-6 dm long, the peduncle often bearing a small leaf; flowers dark purple, 3.75 cm long; calyx appressed puberulent without and within, the lower lobe little exceeding the laterals; pods large 12.5 to 17.5 cm long, very fleshy when green, sparsely puberulent, with weak white hairs, black and slightly falcate when mature, somewhat compressed, the valves mostly having two complete longitudinal ridges and several secondary ones; seeds much flattened, 18-22 mm long, white with scattered black or gray spots.

The species was described from cultivated plants grown from seeds originating in Midnapur, India, where it seems to be known as the spotted bean. Piper quotes it as the "Fleshy-pod bean." According to Mr. A. L. Kenman (India) the bean is sparingly cultivated by the Santals, one of the aboriginal tribes of India. They cook the green pods and also the ripened seeds, but they do not like either very well.

The pods of this species do not dehisce at maturity, but can be broken in pieces without the valves separating.

The species is in all probability a native of India, and undoubtedly will be found to extend outside the Indian peninsula.

Mucuna gigantea (Willd.) DC. Prodr. 2:405. 1825.
Dolichos giganteus Willd. Spec. Pl. 3:1041. 1800.
Carpopogon giganteum Roxb. Hort. Beng. 54. 1814.
Zoopthalmum giganteum Prain in Journ. As. Soc. Beng. 66²:68. 1897.
Stizolobium giganteum Sprengl Syst. 4: Cur. Post. 281. 1827.

Kaee.

Plate 82.

A vine attaining a length of 80 m. glabrous, with terminal or leaf-opposed compound tendrils, leaves 12-20 cm long; petiole 5-12 cm, glabrous; stipules very small, triangular; leaflets 3, glabrous, of a sombre green, oblong, the terminal one attenuate, the lateral ones obliquely rounded at the base, all apiculate, 10-12 cm long, 7 cm wide; petiolule 5 mm; stipellae 4 mm, filiform; inflorescence axillary, flowers arranged umbellately; peduncle 5 cm, bearing at the apex 4-6 short secondary peduncles, few-flowered; pedicels 1-2 cm, pubescent; calyx subtruncate, 1 cm long, very short-toothed, strigose with appressed stiff hairs in the bud; standard elliptical or obovate, emarginate, 2 cm long, 16 mm wide; wings oblong, free auriculate, ciliate at the back; keel angularly curved, bi-auriculate at the base; stamens diadelphous, anthers hairy; pistil 3 cm long, ovary oblong, hirsute with appressed hair, 2-4-ovuled; pod oblong, flat, coriaceous, 7-10 cm long, 3-4 cm wide, coriaceous, glabrate, without transverse lamellae, the thick margins prominently costate and 2-winged, 2-1-seeded, the papery endocarp soluble, silky glossy and projecting between the seeds; seeds orbicular about 2.5 cm in diam., slightly flattened, uniformly brown or with black lines, the testa hard bony, the rhaphe extending over three-fourths of the circumference.

Mucuna gigantea, while found wild near the shores of the various islands of this group, occurs also in India, Indo-China, Malaya, and the islands of the South Seas.

On Hawaii, in Puna, it covers the rocks near the sea, forming dense masses over a considerable area; on Molokai it is also common at the mouth of Halawa Valley, where it climbs over bushes, forming an impenetrable thicket. The seeds of this species are very variable in color.

Mucuna urens (Linn.) Medic. in Vorles. Churpf. Phys. Ges. 2:399. 1787.
Dolichos urens Linn. Syst. Nat. ed. X; 2:1162. 1759.

A tall climber, the young shoots silky with fine stinging hairs; leaflets ovate 6.25-12.5 cm long, 3.75-7.5 cm wide, the lateral ones oblique, acuminate, densely sericeous underneath; peduncle flexuose, 10-15-flowered; flowers in fascicles;

bracteoles ovate, obtuse, silky 9 mm long; flowers large, 5 cm long, bright yellow, with some red, very showy; calyx 2.5 cm, silky, unequally four-cleft, the lowest lobe as long as the tube; standard reflexed, ovate-lanceolate, two-thirds the length of the wings; pod sessile, compressed, oblong, with numerous transverse lamellae, hirsute with fulvous, stinging hair, usually one-seeded; seeds orbicular, black, dull, 2.5 cm in diam.

Mucuna urens is a native of tropical America, extending to the West Indies, Brazil, and Peru. In Hawaii it has been collected by Gaudichaud, J. Remy, Mann & Brigham, and the writer.

According to Hillebrand it is said to occur on Maui above Makawao, and on Hawaii at Waimea. The writer found it on the lee side of Kauai, in the rocky regions back of Waialua-Kekaha.

DIOCLEA H. B. K.

Calyx oblique, upper two segments united into a single entire broad segment, the lateral smaller, the lower elongate. Standard reflexed, ovate to orbicular; wings oblong or obovate, free, as long or shorter than the recurved, obtuse or beaked keel. Upper stamens free at the base, but otherwise united with the others. Ovary very shortly stipitate, with two to many ovules. Style incurved, thickened or dilated at the apex, with terminal, often oblique, truncate stigma. Pod linear-oblong, flattened or rarely turgid, both sutures narrowly winged, or only upper suture thickened, 2-valved. Seeds suborbicular or subreniform, with short or long, linear rhaphe. Tall winding shrubs with trifoliolate leaves and stipellae. Flowers violet or white or blue, in terminal usually elongate racemes.

About seventeen species, the majority of which occur in tropical America; few in the tropics of the old world. One species occurs naturally in the islands.

Dioclea altissima (Velloso) Rock, comb. nov.

Dolichos altissimus Velloso Flor. flum. 320; 7:134. 1790.

Mucuna altissima Boj. ex Benth. in Ann. Wien. Mus. 2:133. 1838. Not DC.

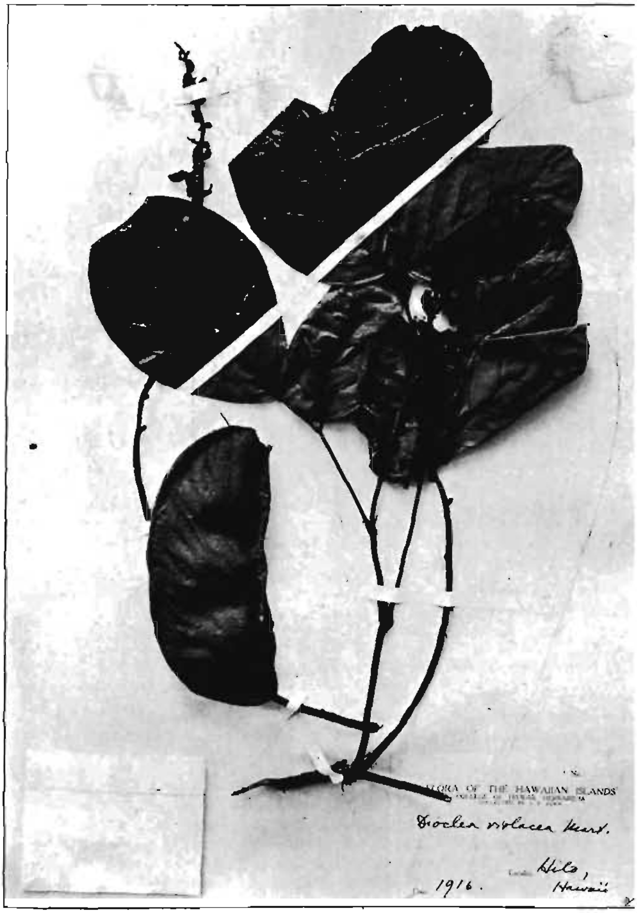
Dioclea violacea Mart. ex Benth. in Ann. Wien. Mus. 2:132. 1838.

Maunaloa.

Plate 83.

Stems tall twining; young branches and petioles more or less pubescent; stipules semi-sagittate, lanceolate, 6-8 mm long; petioles 7.5-10 cm; stipels subulate 4-6 mm long; leaflets 10-12.5 cm long, about 7.5 cm wide, shortly acuminate, rounded at the base or subcordate, the lateral ones oblique, subcoriaceous, shining above, and scattered hairlets or glabrate, with lax hair more or less silky pubescent beneath; peduncle 15-30 cm long, thick and rigid, terete at the base, angular between the flowers, and more or less reddish or rusty-brown-tomentose, floriferous below the middle; bracts linear 8-12 mm, caducous in old racemes; pedicels 2-4 mm long; bracteoles small orbiculate; calyx campanulate subglabrous outside or hairy, silky inside, tube 8 mm long, upper segment half as long as the tube, broad, very obtuse, the lateral ones of even length, broadly falcate, acute; standard twice as long as the calyx, orbicular, reflexed, claw 6 mm long; wings clawed, 8 mm long, oblique and broadly ovate, 18 mm; keel much shorter than the wings, acute and subrostrate; anthers 5 fertile, oblong, 5 sterile, small, or lanceolate-acuminate; ovary sessile, ovules usually 3; discus short, obtusely dentate; pod about 7.5 cm-12.5 cm long, up to 5.5 cm wide, thick coriaceous, tricarinate at the

PLATE 83.



DIOCLEA ALTISSIMA (Velloso) Rock
Maunaloa.

ventral suture, densely fulvo-tomentose when young, glabrous when mature; seeds 2 or 3, nearly orbicular, compressed 18-20 mm in diam. with a bony testa, the linear rhaphe extending more than half way round the circumference.

A native of Brazil, where it is found in the strand forests; also found wild in Hawaii, where it occurs on the Islands of Hawaii and Kauai, and probably elsewhere in the islands. On Hawaii it occurs in Hilo and Puna. Hillebrand states that it is also found in the Society and Fiji Islands.

The specific name *altissima* is much the oldest and is based on *Dolichos altissimus* of Velloso (1790), but that name was also used by Jacquin in the same genus (*Dolichos* 1762); this latter is a synonym of *Mucuna altissima* (Jacq.) DC. According to the American code of nomenclature the name of *altissimus* could not be used in any genus, but the writer thinks it best to adhere to the international code, and according to that the proper combination is *Dioclea altissima* (Velloso) Rock.

PUERARIA De Candolle

Slender or coarse, herbaceous or suffrutescent vines with three-foliolate leaves, the leaflets stipellate. Flowers small to large, in few to many-flowered, simple or compound racemes. Calyx teeth long or short, the upper two connate. Corolla exserted; standard as long as the wings and keel. Stamens monadelphous. *Ovary many-ovuled. Pod linear, compressed.*

The genus *Pueraria* consists of about fifteen species, distributed from India to Japan and southward to Malaya and the Philippines. Only one single species, *P. thunbergiana* (Sieb. et Zucc.) Benth. is in cultivation in Hawaii, and especially in Honolulu.

Pueraria thunbergiana (Sieb. et Zucc.) Benth. in Journ. Linn. Soc. Bot. 9:122. 1865.

Dolichos hirsutus Thunb. in Trans. Linn. Soc. 2:237. 1794. Non *Pueraria hirsuta* Kurz 1873.

Pachyrhizus thunbergianus Sieb. et Zucc. Fl. Jap. Fam. Nat. 2:113. 1846.

Neustanthus chinensis Benth. Flora Hongk. 86. 1861.

A coarse, scandent, pubescent, annual herbaceous vine reaching a length of at least 8 m with a large tuberous rootstock, leaflets ovate, acuminate, entire or slightly repand, 10 to 20 cm long, the upper surface glabrous or nearly so, the lower surface rather densely pubescent with soft, grayish hairs; stipules peltate; racemes axillary 15 *to 30 cm long; flowers about 2 cm long; calyx pubescent, the* lobes acuminate; corolla rather bright purple, the standard 2 cm broad, with a rather large yellow spot near the base; pod 5 to 8 cm long, about 1 cm wide, hirsute with spreading brown hairs.

PLATE 84.

CANAVALIA LINEATA (Thumb.) DC.

This species is a native of Japan, China, Formosa, the Philippines, Korea, and India, and is cultivated in Hawaii by Chinese truck gardeners on account of its large edible tubers.

CANAVALIA Adanson

Calyx bilabiate, upper lip large, truncate or two-lobed, lower lip much smaller entire or 3-lobed. Standard reflexed, large, suborbicular or broadly ovate, with or without auricles at the base. Wings narrow, drepaniform, free; keel incurved, broader than the wings, obtuse or obtusely beaked. Upper stamens free at the base, united with the others at the middle. Ovary sessile or shortly stipitate with many ovules. Style incurved, with terminal, small, capitate stigma. Pod oblong, or broadly linear, flattened or sometimes swollen, with a rib on each valve near the upper suture. Seeds large ovate or suborbicular, compressed. Winding or prostrate herbs with 3-foliolate leaves, with stipellae. Flowers usually large, purplish-red, or whitish in axillary racemes.

About twelve species in the warm regions of both hemispheres. One species (*C. galeata*) is endemic in Hawaii.

Numerous varieties and hybrids of both *C. ensiformis* and *C. gladiata* are under cultivation at the H.S.P.A. Experimental plot in Honolulu. A few other species, as yet not determined, are also cultivated by the same institution. Wild occur only *Canavalia microcarpa*, which can be found on the windward side of Oahu, as at Aiea, Hauula, etc.

C. galeata and the variety *pubescens* are peculiar to the Hawaiian Islands, and are mountain species.

C. sericea is also a native and occurs wild on the Island of Lanai, near the sea; it occurs, however, also on the Society Islands and the Fiji group.

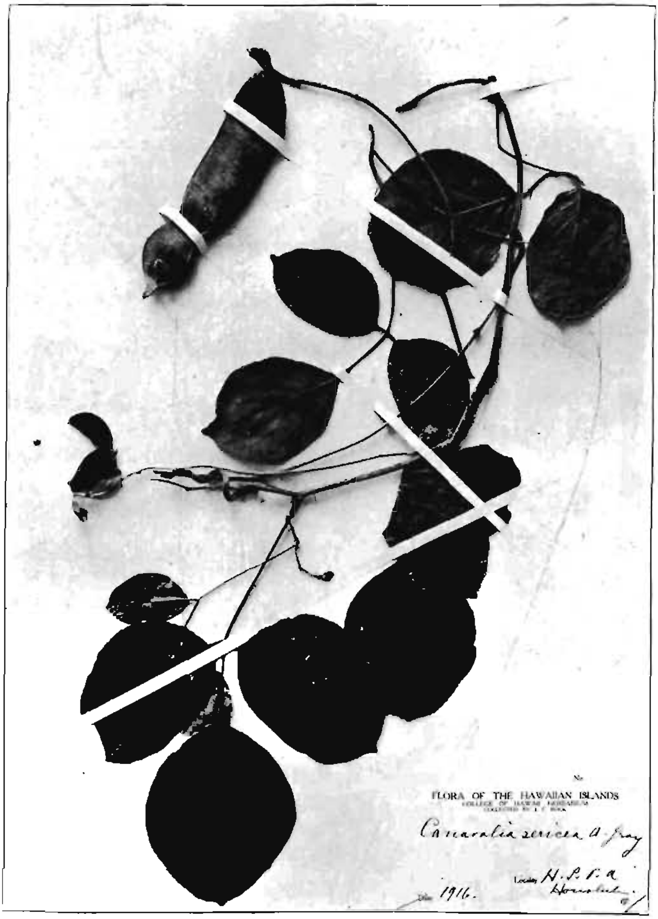
KEY TO THE SPECIES.

Pod turgid often nearly flat along the dorsal suture 10 cm long, about 4.5 cm wide; leaflets acuminate .... **C. microcarpa**

Pods usually flat.

- Pods straight or nearly so.
  - Leaflets rounded at both ends, even emarginate at the apex, glabrous .... **C. lineata**
  - Leaflets acute or acuminate, glabrous or pubescent.
    - Leaflets acute, apiculate silky pubescent or glabrate.
      - Pod fawn-colored, 10 cm long, silky glossy, leaflets silky .... **C. sericea**
      - Pod black when mature papery, thin, leaflets glabrate or pubescent beneath .... **C. galeata et var. pubescens**
    - Leaflets acuminate.
      - Pod less than 20 cm long, 3 cm wide, seeds white .... **C. ensiformis**
      - Pod 25-30 cm long, 4-5 cm wide, seeds red .... **C. gladiata**
- Pod semicircular .... **C. campylocarpa**

PLATE 85.



CANAVALIA SERICEA A. Gray

Canavalia microcarpa (DC.) Piper in Biol. Soc. Wash. 30:176. 1917.*

Canavalia microcarpa (DC.) Merrill An Interpr. of Rumph. Herb. Amboin. 280. 1917.

Lablab microcarpus DC. Prodr. 2:402. 1825 (type).

Canavalia turgida Grah. in Wall. Cat. no. 5534. 1832.

A coarse, scandent, herbaceous vine; leaflets ovate, acuminate 8-15 cm long usually rounded at the base; flowers in pairs at the ends of the scapes, reflexed about 4 cm long, pinkish-purple, similar to *C. lineata*; pods thick, broad, swollen, often nearly flat along the back, 10-14 cm long, 5 cm wide, apiculate-acuminate containing about six brownish-black, ellipsoidal, somewhat compressed, hard smooth seeds.

A native of tropical Asia, from India to Malaya, Formosa, and the Philippines. This species, previously known as *Canavalia turgida*, is quite common in the lowlands on probably all the islands. It grows usually near the sea, climbing over rock walls and shrubs, but is never found on the beach proper.

Canavalia lineata (Thun.) DC. Prodr. 2:404. 1825.

Dolichos lineatus Thunb. Flor. Jap. 280. 1784.

Canavalia obtusifolia DC. Prodr. 2:404. 1825.

Dolichos obtusifolius Lam. Encycl. 2:295. 1786.

Plate 84.

Stem often 2 m long, prostrate, whole plant glabrous or silky pubescent when young; petioles fleshy, 5-10 cm long; leaflets usually 5-7.5 cm long fleshy, obtuse or retuse (emarginate) at the apex; racemes 15 cm or more long flowers rose-colored; calyx lobes unequal, the upper twice as long as the lower the lobes rounded, the lower lobes broad and short; petals as in *C. gladiata*, but the keel much incurved; pod 7.5 cm long or more, 20 mm broad, with narrow wings along the sutures.

This species is common along the seashore on the coasts of India, Japan Malay, Australia, and tropical America. It grows in pure sand on the beach

Canavalia lineata is considered a dangerous plant and is encountered in all tropical countries. It was unknown in Hawaii, but has been of late under cultivation at the Hawaiian Sugar Planters' Experiment Station. The seeds were brought from Trinidad by Gerrit P. Wilder.

The danger, should the plant spread, would be mainly to livestock if eaten by the latter, as the plant contains prussic acid. The poisonous properties of this species may provoke a distension of the stomach which is capable of producing death.

Seeds imported for the U. S. Department of Agriculture, Washington, D C., under the name *C. rosea*, produced plants identical with *C. lineata*. They were grown at the H.S.P.A. plot by Dr. H. L. Lyon.

Canavalia sericea A. Gray U. S. Expl. Exp. 1:440. 1854.

Plate 85.

A winding herb or suffrutescent climber, with silky tomentose stems and branches; stipules ovate subulate, caducous; leaflets rounded obovate, retuse o

*Piper's combination antedates that of Merrill by one week.

PLATE 86.

CANAVALIA GALEATA PUBESCENS (H. et A.) Gray
Awikiwiki and Puakaihi.

emarginate, thickish 7.5-10 cm long, 6.5-8.25 cm wide, silky pubescent, but at length glabrate above, (not in the Hawaiian plant, Rock) very silky beneath with a thick and somewhat silvery pubescence; the petiole, inflorescence, etc., downy; racemes several-flowered, short-peduncled, nearly as long as the leaves; flower 3.75 cm long; calyx almost glabrous, the large upper lip emarginate two-lobed, the short lower lip three-cleft; its lobes broadly triangular, acute, of equal length; ovary canescently tomentose; pod tomentulose, oblong or oblong-linear 7.5-10 cm long, 2.5 cm wide, straight compressed, raised on a stipe 1.25 cm long; seeds 3 or 4.

Canavalia sericea is distinctly a South Pacific species, occurring in Fiji and other islands of the Pacific.

The Hawaiian plant, which was collected on the Island of Lanai, near the shore, climbing over *Cordia subcordata* trees at Manele in the dry western region of that island, differs from the description by Gray and the one published by Seemann mainly in the following points:

In the species the carina (keel) is supposed to be the length of the wings. In the Hawaiian specimen the wings are considerably shorter than the keel; the leaves are pubescent above instead of entirely glabrous; otherwise the description tallies. So far the plant has only been recorded from the Society Islands and the Fiji group, and in 1910 was discovered by the writer on the Island of Lanai, for the first time north of the equator.

The plant from Lanai may be worthy of varietal rank. (*Canavalia sericea lanaiensis* Rock v. n.)

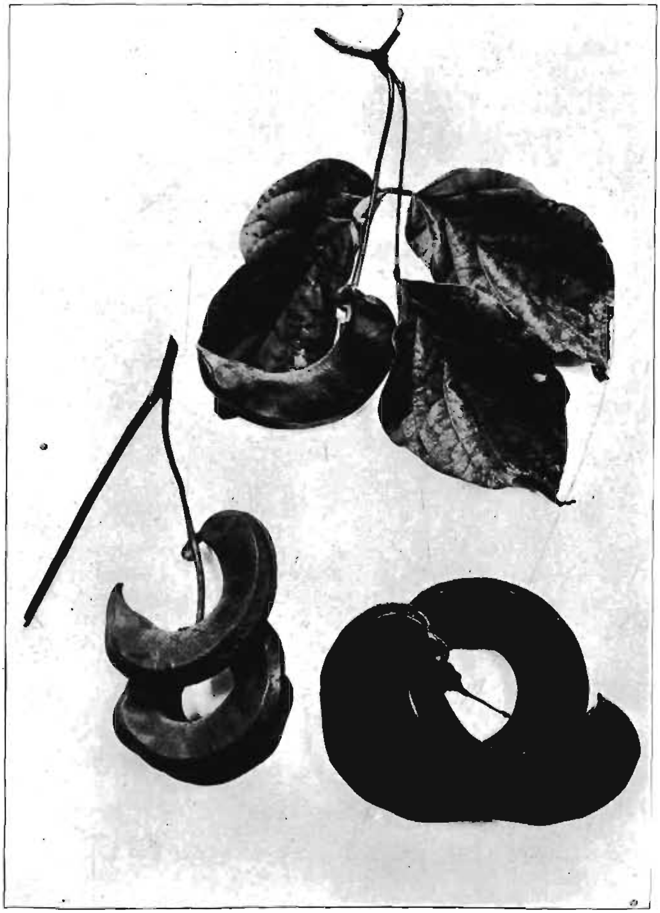
The plant here figured is from a specimen grown from the Lanai seed at the Hawaiian Sugar Planters' Experiment Station by Dr. H. L. Lyon. The cultivated plant is much less coriaceous and has larger leaves than the wild plant on Lanai; the pods are also larger and thicker.

Canavalia galeata Gaud. Bot. Voy. Uranie 486. 1826. Admot.
Dolichos galeatus Gaud. Bot. Voy. Uranie 486, plate 115 (not 15). 1826.
Canavalia Gaudichaudii Endl. in Fl. Ins. Austral. Ann. Wien. Museums 1:186. 1836.

Awikiwiki and *Puakauhi.*

Stem slender, twining, the young shoots and the leaves more or less pubescent when young, soon glabrate or nearly glabrous in most cases; stipules minute, ovate subulate, caducous; leaflets ovate-elliptical or oblong ovate, more or less acuminate, rounded at the base, membranous, 7.5-12.5 cm long, green and glabrate on both sides, (or pubescent underneath) as are the partial petioles; racemes 3-10-flowered, rather shorter than the leaves; flowers 2.5-3.75 cm long; upper lip of calyx recurved in flower, strongly emarginate or somewhat two-lobed, the lobes rounded; the short lip three-cleft, its lateral lobes ovate or triangular-ovate and obtuse, the middle one more triangular and acute; corolla purple, the obovate and emarginate standard rather longer than the wings and keel; androecium and pistil almost straight; ovary silky canescent, many-ovuled; pod linear-oblong 10-12.5 cm long, 2.5 cm or more in width, straight compressed, glabrous, minutely silky when half grown, slightly tricarinate at the ventral suture, apiculate, shortly stipitate; seeds 6-7.

PLATE 87.



CANAVALIA CAMPYLOCARPA Piper

The species is peculiar to these islands, and was originally discovered by Gaudichaud of the French Exploring Expedition Uranie.

The U. S. Exploring Expedition collected the species on the Island of Oahu, near the coast in the Waianae range. A specimen ex coll. Hillebrand in the College of Hawaii Herbarium has very large leaves, which are acuminate at the apex; they are, however, also slightly pubescent beneath.

Specimens collected by the writer in the mountains of Lanai, in Kaiholena Gulch, belong to the species, but the leaves are also somewhat pubescent, as is the calyx.

Canavalia galeata pubescens (Hook. et Arn.) A. Gray in U. S. Expl. Exp. 441. 1854.
Canavalia pubescens Hook. et Arn. Bot. Beech. Voy. 81. 1841.

Plate 86.

Leaves, petioles, petiolules pubescent, leaflets even when old densely grayish pubescent, calyx green glabrate; pod black, papery, glabrate when mature.

Specimens of this variety were first collected by Gaudichaud, Chamisso, Lay & Collie, and Douglas. The writer's material came from the Island of Hawaii, where the variety is not uncommon in the dry woods of North and South Kona, on ancient lava flows at an elevation of 2000 feet.

Canavalia ensiformis (Linn.) DC. Prodr. 2:404. 1825.
Dolichos ensiformis Linn. Spec. Plant. 2:725. 1753.

Jack-bean.

A scandent herbaceous or suffrutescent vine reaching a length of from 2 to 5 m, nearly glabrous, or some parts more or less pubescent; leaflets narrowly ovate to oblong ovate, acuminate or acute, base usually rounded, 8-16 cm long; racemes axillary, solitary, up to 40 cm long, flowering only near the apex, only 2 to 3 flowers open at a time; flowers nearly sessile, reflexed; calyx green, about 1.5 cm long, the upper lip cleft into two broad lobes, the lower reduced to three small teeth; corolla pink, about 3.5 cm long; pod 14-17 cm long, 2-2.5 cm wide, flattened not turgid, 8-10 mm thick along the upper suture, containing about 15 seeds.

This exceedingly variable species, of the tropics of the old world, is cultivated in Hawaii more or less extensively.

The Jack bean has principally been used in Hawaii, and that with varied success, in feeding cattle and swine. Cattle have been poisoned on Oahu by being fed the green pods and plants. The writer examined the stomach contents of a cow which died rather suddenly; the contents were exclusively that of *Canavalia ensiformis.* Beasts usually do not relish the stems of Jack beans. According to Krauss the Jack bean yields from 38-47.5 tons of green forage to the hectare in Hawaii. The best crop of seeds was 1420 kilos to the hectare.

While the advantages of the Jack bean are very numerous, its value as a green manure outweighs them all. When the Jack bean is left to ripen the leaves on the stem wither, and when the remainder of the crop is ploughed in

the amount of fertilizing matter is not so large. The amount of matter withdrawn from the soil by the ripe pods is considerable, and it becomes necessary to use the empty husks to obtain farmyard manure.

Leaves as analyzed by Mrs. Krauss contain the following fertilizing elements:

Potash	0.65	per cent
Lime	0.78	" "
Phosphoric acid	0.16	" "

The composition of the leaves is as follows:

Water	76.81	per cent
Ash	2.70	" "
Cellulose	6.36	" "
Fat	0.48	" "
Non-nitrogenous matter	8.44	" "
Nitrogenous matter	5.21	" "

One thousand kilos of this matter amounts to 8.3 kilos of nitrogen, 1.6 kilos of phosphoric acid, 6.5 kilos of potash, and 7.8 kilos of lime.

Canavalia gladiata (Jacq.) DC. Prodr. 2:404. 1825.
Dolichos gladiatus Jacq. Coll. 2:276. 1788.

Sword-bean.

A glabrous vine reaching a length of several meters; leaflets ovate, somewhat acuminate, 8-15 cm long, racemes axillary, long peduncled, few-flowered; flowers white, turning pink, about 3 cm long; pods large narrowly oblong, somewhat curved, 25-35 cm long, 4-5 cm wide; seeds red.

The sword bean is in all probability a native of tropical America, but is now cultivated in many tropical countries. According to Sornay, the pods are eaten green, like haricot beans, by Europeans, and are supposed to have a distinctive flavor which is said to be pleasant. It is considered to be the best Indian legume.

Canavalia rusiosperma Urban Symb. Antill. 1:473. 1900.

This species, described by Dr. I. Urban, is a native of the West Indies. Specimens are cultivated at the Hawaiian Sugar Planters' Experiment Station.

Canavalia campylocarpa Piper in Proc. Biol. Soc. Wash. 30:175. 1917.

Plate 87.

Herbaceous annual; stems twining, green, branching, minutely and sparsely appressed puberulent with white hairs, growing to a height of 2-4 m; leaves trifoliolate; petioles about as long as the leaflets, shallowly channelled above, sparsely puberulent, petiolules somewhat swollen; leaflets membranous, ovate to oblong ovate, short-acuminate, 10-18 cm long, stipules triangular, acuminate, ciliate, 3 mm long; stipellae linear; peduncles exceeding the subtending leaves; racemes 5-10-flowered; pedicels very short; calyx green, sparsely puberulent, 10-12 mm long the upper lobes rounded at the apex, united, emarginate, the three lower lobes small, subequal, triangular, acute; corolla pink; standard erect,

broadly oval, deeply notched at the apex, white in the center; wings closely enveloping the keel, 1.5 cm long; keel obtuse at the apex; pods much compressed, curved into a semicircle, 6-10 cm long, 2.5 cm broad, wax-yellow when immature, brown when ripe, longitudinal ridges small, the two posterior close to the dorsal suture, the other two parallel and distant one-fifth of the width of the pod; seeds oval, compressed, 12-18 mm long, wax-brown.

Seeds of this species were received by the H.S.P.A. from Ch. V. Piper of the Department of Agriculture, Washington, D. C. They were grown by Dr. H. L. Lyon at H.S.P.A. Experimental plot.

Piper says that it is presumably a native of the West Indies, and has been under cultivation in various places in Florida and Mississippi, but has shown little promise of having value in those States.

CAJANUS De Candolle

Calyx campanulate, with acuminate segments, the upper two united, bidentate. Standard recurved, suborbicular with inwardly bent auricles at the base; wings oblique-obovate; keel with incurved, obtuse apex. Upper stamen free. Ovary subsessile, many ovuled. Style slender, thickened beyond the middle, dilated below the terminal, oblique, capitate stigma. Pod linear, obliquely pointed, flattened, 2-valved, with oblique depressions between the seeds, 3-5 seeded.

An erect suffrutescent herb or shrub, with 3-foliolate leaves. Stipules long, subulate, caducous. Flowers yellow in axillary, pedunculate racemes.

The genus *Cajanus* consists of a single species, which is probably indigenous in Africa, but is now cultivated and naturalized in the tropics of both hemispheres.

Cajanus cajan (Linn.) Millsp. in Field Columb. Mus. Bot. 2:53. 1900.
Cytisus cajan Linn. Spec. Plant. 739. 1753.
Cytisus pseudo-cajan Jacq. Hort. Vind. 2:54, t. 119. 1772.
Cajan inodorum Medic. in Vorles. Churpf. Phys. Ges. 2:363. 1787.
Cajanus bicolor DC. Cat. Hort. Monsp. 85. 1813.
Cajanus indicus Sprengl Syst. 3:248. 1826.

Pigeon-pea.

Plate 88.

An erect branched, pubescent shrubby plant 1 to 2 m high; leaflets 3, oblong lanceolate to oblanceolate, acuminate, 3 to 10 cm long, dotted underneath, and grayish, on petiolules 12 mm; stipules lanceolate, caducous; peduncles axillary, bearing at the summit a short raceme with few flowers, the latter either entirely yellow, or the standard veined outside with purple, 1.5 cm long; bracts deciduous; calyx lobes subulate, recurved; pod linear, straight, narrowed at both ends, 3 to 5-seeded, with oblique depressions between the seeds, 5-7.5 cm long, more or less hairy and glandular; seeds mottled.

The Pigeon pea is a native of tropical Asia, but now generally cultivated for its seeds in most tropical countries. It is commonly cultivated throughout

PLATE 88.

CAJANUS CAJAN (Linn.) Millsp.
Pigeon-pea.

the islands, and was especially planted during the period of the war in waste places, vacant lots, along roadsides, etc., though not much use seems to have been made of its seeds for food. In India the pea is boiled and made into a sauce known as Dhal, which is eaten with curry. It is extensively cultivated in the United Provinces, as in the district of Benares, from where the writer brought seeds with him. The plants are not at all luxuriant there, but are rather slender, single-stalked, with very few leaves and flowers.

As a green manure the pigeon pea cannot possibly give such good results as the trailing *Leguminosae*. Its roots penetrate fairly deeply into the soil and mineral elements are taken not only from the arable layer, but also from the subsoil. For composition of the forage portion of the plant, see Krauss Bulletin No. 23, Hawaii Agricultural Exper. Station.

FLEMINGIA Roxburgh

Calyx short, campanulate with subequal, acute teeth, of which the lower is usually longer than the rest. Standard elliptical, obovate or orbicular, with incurved auricles at the base; wings oblique, oblong or obovate, sometimes adhering to the acute or obtuse keel. Upper stamens free, ovary sessile or very shortly stipitate, 2-ovuled. Style filiform or slightly thickened towards the apex, with small, terminal, capitate stigma. Pod short and oblique, inflated, 2-valved. Seeds 1 to 2, with short hilum.

Erect, prostrate or winding herbs, suffrutescent herbs or shrubs with trifoliolate leaves. Flowers red, purple, purple and yellow in dense or paniculate racemes.

About twenty species, distributed throughout the tropics of the old world. The only species found wild in Hawaii, and probably of very recent introduction, is *Flemingia strobilifera* (Linn.) R. Br.

Flemingia strobilifera (Linn.) R. Br. in Ait. Hort. Kew. ed. 2, 4:350. 1812.
Hedysarum strobiliferum Linn. Spec. Plant. 764. 1753.

An erect shrub up to 3 m high, branches slender terete, velvety; leaves oblong, subacute, broadly rounded at the base, subcoriaceous 7.5-20 cm long, green glabrescent above, thinly silky, especially on the raised parallel ribs below; stipules scariose, linear 6-12 mm long; petiole stiff, 2.5 cm long; racemes 7.5-15 cm long, usually simple, the slender zigzag rhachis densely gray downy; bracts deeply cordate, 12-24 mm long, membranous, finely downy, rather broader than long, obscurely cuspidate; calyx 6 mm, pilose, teeth lanceolate, exceeding the tube; corolla purple little exserted; pod oblong, turgid 6-10 mm long, pubescent, 2-seeded.

A native of India, Siam, Malayan Islands, Ceylon, Philippines, and Timor. Introduced into Mauritius and the West Indies. The species has been found by Mr. Austin of Nahiku, Maui, where it grew in a guava field. Recorded by C. N. Forbes. Not seen by the writer.

PHASEOLUS LATHYROIDES Linn.

PHASEOLUS Linnaeus

Calyx campanulate or short-tubular, upper two segments united or free. Standard orbicular, erect wings obovate, rarely oblong, adhering to the keel beyond the claw; keel linear to obovate, with long obtuse, spirally twisted beak. Upper stamen free, thickened at the base or with appendages. Ovary subsessile surrounded by a distinct, cup-shaped discus, many-ovuled. Style long, thickened within the beak of the keel and twisted with the latter, bearded along the ventral side, with oblique stigma. Pod linear to oblong, terete or compressed, straight or curved, 2-valved.

Winding or prostrate, rarely somewhat erect herbs with ligneous base and 3-foliolate leaves, rarely only one, with stipellae. Flowers white, yellow, violet, red or purple, in axillary racemes.

About 150 species in the warmer regions of both hemispheres. Several species are in cultivation in the islands.

KEY TO THE SPECIES.

Stipules small basifixed; flowers usually pink or purple.
- Erect herbs with appressed-pubescent narrow pods and dark purple flowers ..... **Ph. lathyroides**
- Twining vines with broader glabrous pods and greenish-yellow or pale purple flowers.
  - Flowers less than 2 cm long.
    - *Pods broad flat, 1.5 to 2 cm wide, flowers greenish-yellow, less than 1 cm long* .... **Ph. lunatus**
    - Pods swollen less than 1.4 cm wide, flowers 1.5 to 2 cm long, pale purple or pink and white .... **Ph. vulgaris**
  - Flowers about 2.5 cm long .... **Ph. adenanthus**

Stipules produced below the point of insertion; flowers yellow; pods hirsute with spreading hair .... **Ph. aureus**

Phaseolus lathyroides Linn. Spec. Pl. ed. 2, no. 1018. 1763.
Phaseolus semierectus Linn. Mant. 100. 1771.

Plate 89.

An erect suffrutescent, somewhat branched plant, 1-1.5 m high (but usually less), the branches often flexuous, rarely twining, clothed with deflexed hairs; leaflets oblong to oblong-ovate, 4 to 7 cm long; stipules lanceolate, acuminate, 6 to 8 mm long; racemes axillary, long peduncled, the racemes 20 cm long or less, the peduncles as long or longer, the flowers about 2 cm long; calyx green, 6 to 7 mm long; standard about 1 cm wide, greenish-purple, wings straight and free 18 mm long, exceeding the other petals, dark purple in the upper portion as is the keel, greenish below; ovary silky; pod linear, reflexed 8 to 10 cm long, about 4 mm wide subterete when ripe, the thin valves twisted after opening; seeds numerous, oblong or angular, 2 to 3 mm, dark brown, mottled, with a short oblong hilum.

A native of tropical America, but now widely distributed over the tropics of the old world.

It is one of the most common weeds in grass lands, lawns, along the roadsides, etc., and is now widely distributed in Hawaii. It is especially common after the winter rains from January to the summer months.

The species is a favorite with cattle, owing to its high nutritive values. The roots show that it possesses nodules in a much higher proportion than any other

PLATE 90.

PHASEOLUS LUNATUS Linn.
Lima-bean.

variety of cow pea, according to de Sornay, but owing to the woody nature of the stem it is not very well adapted to ploughing under.

Phaseolus lunatus Linn. Spec. Plant. 724. 1753.

Lima-bean.

Plate 90.

A scandent, slender annual, glabrous or sparingly pubescent, herbaceous vine reaching a length of 4 m or more, the stipules small, basifixed; leaflets ovate, acuminate, thin, 6 to 12 cm long; racemes axillary, solitary, peduncled, 8 to 20 cm long; flowers long-pedicelled, about 13 mm long, the calyx pale-greenish, the corolla much longer than the calyx, greenish or pale-yellowish; pods oblong, somewhat curved 6 to 12 cm long, about 2 cm wide, containing from 1 to 4 large, variously colored or white seeds.

The *Lima Bean*, a native of tropical America, is now cultivated in all tropical and warm countries on account of its edible beans. It flowers from September to April.

Phaseolus vulgaris Linn. Spec. Plant. 723. 1753.

Common Kidney-bean.

An annual nearly glabrous or slightly hairy, erect, branched plant or a slender twining vine; leaves 3-foliolate, the leaflets ovate, acuminate, base rounded, 7 to 11 cm long, the lateral ones inequilateral; racemes axillary, few-flowered, shorter than the leaves, the pedicels longer than the calyx; flowers white, turning straw-colored or somewhat pink-purplish, 1.5 cm to 2 cm long; bracteoles ovate green, persistent; pods linear, somewhat curved, 10 to 15 cm long, about 1 cm wide.

The country of origin of the *common Bean* is not known. It is cultivated in all warm countries. In Hawaii it is grown mainly by the Chinese for the local market.

Phaseolus multiflorus Willd., a synonym of which is *Ph. coccineus* Lamk., differs from *Phaseolus vulgaris*, the common Kidney bean, in the long racemes, which often overtop the leaves, and in the flowers, which are bright scarlet. It is commonly known as the "Red-runner," and is cultivated at Schofield on Oahu and elsewhere.

Phaseolus adenanthus G. W. F. Mey. Prim. Fl. Esseq. 239. 1818.
Phaseolus Truxillensis H. B. K. Nov. Gen. Am. 6:451. 1823.
Phaseolus rostratus Wall Pl. As. Rar. 1:50, t. 63. 1830.

A slender, glabrous, twining herb (herbaceous vine) 2 to 5 m or more in length; leaflets firm, 8 to 14 cm long up to 5 cm wide, oblong-ovate, entire, acute or acuminate, base rounded, 3-nerved, appressed silky pubescent; racemes axillary, long peduncled, flowers few, crowded at the apex; flowers 2.5 to 3 cm long; calyx green or purplish, the three lower teeth lanceolate, acuminate, the two

PLATE 91.

VIGNA OWAHUENSIS Vog.

upper shorter, wholly or partly connate; standard 3 to 3.5 cm wide, retuse, white, tinged with purple; wings with more purple than the standard; keel white, all petals turning brownish-yellow before falling; pods linear, recurved, flat, many-seeded, 8 to 10 cm long, about 1 cm wide, acuminate.

A cosmopolitan of the tropics. It is reported from Hawaii as occurring on Diamond Head, Oahu, by the U. S. Exploring Expedition, and also from Hawaii, where it was collected by J. Remy. It has also been collected by Menzies, Nuttall, and Macrae. Neither Hillebrand nor the writer came across this species. It was collected last by J. Remy in 1851.

Phaseolus aureus Roxb. Hort. Beng. 55. 1814. Nomen nudum, Fl. Ind. ed. 2, 3:297. 1832.

Phaseolus mungo auctt., non Linn.

Phaseolus radiatus auctt., non Linn.

Mung-bean.

An erect or climbing annual herb, branched from the base, or more or less clothed with spreading, brownish hairs; leaflets ovate, entire, acuminate, 8 to 15 cm long, the lateral ones inequilateral; flowers about 1 cm long, yellow, racemosely arranged near the ends of the short peduncles, the pedicels very short; pods linear, spreading, 6 to 8 cm long, about 6 mm wide, hirsute with scattered, long, brownish hairs; seed 4 to 6 mm long.

This is the common Mung bean, a native of the old world, but now cultivated in most warm countries. E. D. Merrill worked out the perplexing synonymy of this species, and he shows that *Phaseolus minimus* of Rumph was originally reduced by Linnaeus to *Ph. radiatus* Linn.

Ph. radiatus Linn. is, however, not the Mung bean, but is the form described by Roxburgh as *Ph. sublobatus.*

Phaseolus max Linn., commonly also referred to the Mung by some authors, is the soy bean *Glycine max* (Linn.) Merr. *Phaseolus mungo* Linn. is a species distinct from *Ph. aureus* Roxb. (*P. radiatus auctt.*), the urd or black grain of India.

The Mung bean is cultivated by the Chinese in Hawaii, who sell the germinated beans as a vegetable in the Honolulu markets.

For further information on the Mung bean, the writer would refer the reader to C. V. Piper's paper, entitled "*Five Oriental Species of Beans*," U. S. Dept. Agricult. Bull. 119, 1-32, t. 1-6, 1914, in which he gives critical consideration of the mung bean and its allies.

VIGNA Savi

Calyx campanulate or somewhat tubular, upper two segments free or united. Standard suborbicular with inbent auricles; wings curved, obovate; keel incurved, as long as the wings, not beaked or ending in a twisted beak. Upper stamen free. Ovary sessile with many ovules. Style filiform or thickened in the

PLATE 92.

VIGNA SANDWICENSIS A. Gray

upper part or membranously dilated, bearded on the inner side, with very oblique incurved stigma. Pod linear, straight, terete, 2-valved.

A genus of over forty species, found in all the tropical regions of the old and new worlds. In Hawaii there are four, or possibly five, species represented.

In cultivation, *V. sinensis*; wild, *V. marina*; and endemic, *V. owahuensis* and *V. sandwicensis*.

KEY TO THE SPECIES.

Pods very long up to 60 cm in length, many seeded.
- Plant tall and voluble .... **V. sinensis**
- Plant low and suberect .... **V. cylindrica**

Pods short, few seeded, 4.5-7 cm long.
- *Plant glabrous, flowers bright yellow* .... **V. marina**
- Plants hirsute, flowers pale lemon-colored, thin.
  - Leaflets small ovate, thin .... **V. owahuensis**
  - *Leaflets linear narrow lanceolate* .... **V. sandwicensis**

Vigna marina (Burm.) Merrill in Interpr. Rumph. Herb. Amb. 285. 1917.
Phaseolus marinus Burm. Index Univers. Herb. Amb. 7:17. 1755. (Type.)
Dolichos luteus Sw. Prodr. Neg. Ind. Occ. 105. 1788.
Vigna lutea A. Gray Bot. U. S. Expl. Exped. 452. 1854.

Nanea and *Pulihilihi.*

A prostrate or climbing herbaceous annual vine, glabrous throughout; leaves trifoliolate; petioles 5-10 cm long; leaflets broadly ovate to oblong-ovate, or suborbicular-ovate, shining, acute or rounded, 5-10 cm long, stipellate; scapes axillary, erect, 10-20 cm long, bearing numerous racemosely arranged flowers at the apex, but two or three flowers opening at one time; flowers yellow, 1.5 cm long, the standard suborbicular, retuse, 1.8 cm wide; pods subcylindrical, 4-5 cm long, 6-7 mm wide, reflexed, each containing from three to six ellipsoidal seeds, 5-6 mm long.

Vigna marina is a native of the tropics of the old world, now widely distributed and common along the sandy seashores. It is not uncommon in the Hawaiian Islands, occurring wild near Waikiki and also along the shore at Waimea, Waialua, Haleiwa, and elsewhere. According to Hillebrand, it occurs on all the islands of this group, besides Fiji and the Society Islands.

The native name of the species is *Nanea* and *Pulihilihi.*

Vigna cylindrica (Linn.) Merrill in Interpr. Rumph. Herb. Amb. 284. 1917.
Phaseolus cylindricus Linn. Amoen. Acad. 4:132. 1759. (Type.)
Dolichos catjang Linn. Mant. 2:269. 1771.

Low and suberect, always glabrous or nearly so; stipules 8-12 mm long attached and persistent; leaflets membranous 7.5-12.5 cm long, acute, very variable in shape, broad or narrow ovate or ovate-rhomboidal with the two sides below the middle prolonged into obtuse lobes; peduncles often exceeding the leaves, 3 to 6-flowered; pedicels very short; calyx glabrous, under 12 mm, teeth lanceolate or deltoid cuspidate; corolla yellow or reddish, twice the calyx; pod in some of the cultivated forms 3 dm long, under 12 mm broad, edible 10 to 20-seeded.

The Cow pea, universally cultivated in the tropics. This is the form with the short pods and by some authors considered identical with *Vigna sinensis* (Linn.) Endl. or as a mere variety of it.

As regards the cultivation of the Cow pea, de Sornay states that the trailing variety (which corresponds to *Vigna sinensis*), should be used in land under rotations, whilst between canes (*Vigna cylindrica*) the non-trailing variety is preferable. To insure their development they should be sown while the canes are still small and have not yet taken possession of the land, their chief advantage being that they cover bare soil unoccupied by the vegetation of the canes.

In a mixed cultivation through canes, either in every row or in every second row, the planting may be from two to two and one-half feet apart, and although it is preferable to sow single plants only, in this case three seeds are sown and the three plants are allowed to remain, the main object being to cover the ground rapidly in order to avoid the growth of weeds.

Vigna sinensis (Linn.) Endl. ex Hassk. Pl. Jav. Rar. 386. 1848.
Dolichos sinensis Linn. Cent. Pl. 2:28. 1756.

This cultivated species of southern China and the Indo-Malayan region is the plant with the very long pods (up to 60 cm). It is tall and voluble, while *V. cylindrica* is low and suberect.

It has been considered a mere variety of *Vigna cylindrica*, commonly known as *Vigna catjang*, and has not always been correctly interpreted, but must strictly be limited to the form of the cow pea with the very long pods.

Vigna owahuensis Vog. in Linnaea 10:585. 1836.
Vigna villosa Hook. et Arn. Bot. Beech. Voy. 81. 1841.
Vigna oahuensis A. Gray Bot. U. S. Expl. Exp. 450. 1854.

Plate 91.

A very slender hispid twiner, the stems slightly hispid with patent retrorse hair; leaflets thin membranous, hispid, small ovate, obtuse at the apex, truncate at the base, the lateral ones somewhat inequilateral, 15-25 mm long, 10-12.5 mm wide, subsessile or on petiolule of 1.5 mm; peduncle filiform about 2 cm or more long, hispidulous, 1-3-flowered; pedicels about 4 mm, the bracteoles very minute; calyx 3 mm, the broad upper tooth obtuse or bidentate, the lowest narrowest and longest, hispidulous; flowers pale lemon yellow, to greenish, large 18-20 mm; standard suborbicular to obovate, wings oblong, two-thirds the length of the standard; keel arched, longer than the wings, acute; ovary hirsute with whitish hair; style curved; pod linear narrow, 4.5 cm long, 4 mm wide, brownish, hirsute, straight, the thin valves twisted after opening, up to 7-seeded, seeds oblong-angular, grayish-mottled, shining 4 mm long, hilum short.

Vigna owahuensis is endemic in the Hawaiian Islands, and was originally collected on Oahu in Makaleha Valley of the Waianae range. According to Hillebrand, Knudsen collected it also on Kauai. The writer found it, not common, however, on the west end of Molokai, on the barren flats among rock, back of Kalaeokailio, in company with *Sida*, *Lipochaeta*, and *Andropogon contortus*, over

which it was twining. It forms spreading prostrate matts, the branches of which are distinctly foliose.

The plant is much relished by sheep and goats.

The Molokai plants have smaller leaves than the Oahu specimens, of which there is a plant in the College of Hawaii Herbarium ex coll. Hillebrand.

Vigna sandwicensis A. Gray Bot. U. S. Expl. Exp. 451, t. 50. 1854.

Plate 92.

Stems twining, slender, retrorsely hispid or minute hirsute-pubescent, as are the petioles, peduncles, and leaves; stipules and stipels subulate, minute; leaflets linear or linear-lanceolate 3-5 cm long, up to 10 mm wide, acute or obtuse, mucronulate, of a rather firm texture, conspicuously reticulated, truncate or retuse at the base, on petiolules of 1 mm; peduncle shorter than the leaf, 2.5 cm or less long, 2-4-flowered; pedicels 6-8 mm long, flowers nearly 2.5 cm long; calyx deeply 4-toothed, subtended by a small deciduous bractlet; corolla pale yellow; standard shortly clawed, obovate, entire, with two callosities and two short auriculate-deflexed appendages; wings narrowly oblong, shorter than the keel, the latter arcuate, or nearly straight, somewhat beaked; stamens diadelphous; ovary hirsute, many-ovuled, style filiform longer than the ovary; pod linear elongate about 7 cm long, 6 mm wide, flattened, straight, glabrate or hirtulose with scattered hairlets, intercepted between the seeds; the latter black, shining, 8-10 in number, oblong-oval, compressed.

Originally discovered by Dr. Pickering on the slopes of Mauna Loa, six miles from the crater of Lua Pele. It occurs also on the mountains of Kauai and Maui.

The writer's specimens came from the slopes of Mt. Haleakala, East Maui, above Makawao, where it is a prostrate twining herb, or suffrutescent herb, as the branches and stem become woody near the base.

Hillebrand records a var. β which may be known as var. *heterophylla*, on account of the dimorphism of the leaves.

Vigna sandwicensis heterophylla Rock.
Vigna sandwicensis β Hillebr. Fl. Hawaii. Isl. 106. 1888.

Upper leaves of pubescent stems narrow lanceolate, to ovate acute, penninerved, 2.5-3.75 cm long, 1.25-2.5 cm wide, lower ones broadly ovate acute or obtuse, or obovate; peduncle 10-15 cm, flowers in fascicles of 2 and 3, on twisted pedicels of 10-12 mm; calyx 6 mm, the upper lobe bidentate, the lowest narrower than the lateral ones; standard 20-24 mm in diameter; wings obovate, keel arched; style curved, but not twisted; seeds 8-15, very dark, almost black, oblong angular 6 mm long.

Collected by Hillebrand at an elevation of 1000-3000 feet on the Island of Maui, above Makawao, and on the Island of Hawaii at Kau.

The plant differs from the species in the dimorphous leaves. A part of the type excoll. Hillebr. is in the College of Hawaii herbarium.

PLATE 93.

DOLICHOS LABLAB Linn.
Papapa-bean.

PACHYRRHIZUS* Richard

Calyx campanulate, the upper segments united into one bidentate segment. Standard broad obovate or orbicular, with two inwardly-bent auricles; wings curved, oblong, as long as the incurved keel. Upper stamen free. Ovary sessile or subsessile with several to many ovules. Style with thickened, inrolled apex, bearded along the inner side. Stigma subglobose, shortly stipitate, below, the in-rolled apex. Pod linear, flat, depressed between the seeds. Tall winding herbs with trifoliolate leaves, with stipellae. Flowers in axillary, elongated paniculate racemes.

The genus consists of two species, the one here discussed and of wide distribution (America and Asia), and a second species, a native of Mexico. The former is cultivated on account of its turnip-shaped root, which is eaten raw and cooked.

Pachyrrhizus erosus (Linn.) Urban Symb. Antill. 4:311. 1905.

Dolichos erosus Linn. Spec. Plant. 726. 1753.

Dolichos bulbosus Linn. Spec. Plant. ed. 2, 1021. 1763.

Pachyrrhizus angulatus Rich. ex DC. Prodr. 2:402. 1825.

Pachyrrhizus bulbosus Kurz. in Journ. As. Soc. Beng. 45²:246. 1876.

Cacara erosa O. Kuntze Rev. Gen. Pl. 1:165. 1891.

Yam bean.

A coarse scandent, herbaceous vine, somewhat pubescent, from rather large, edible turnip-shaped, fleshy roots; leaflets at least the terminal one broader than long, up to 15 cm long and 20 cm wide, deltoid at the base, irregularly and shallowly lobed in the upper half, mucronate at the apex at the point of the median nerve; common petiole 7-15 cm, petiolule 5 mm; the lateral leaflets asymmetrical; inflorescence axillary, a long raceme, 45 cm in length, peduncle robust, naked for 15-20 cm of its length; pedicels 5 mm, the lower nodes produced into short branches, each node with several flowers, the lower nodes 25 mm apart; flowers pale blue; bracts lanceolate, 6 mm long, bracteoles small, caducous; calyx shortly pubescent, campanulate, 4-toothed; petals long-clawed; standard orbicular 15-18 mm in diam.; wings oblong, keel somewhat falciform, obtuse; stamens diadelphous; ovary pubescent, style pubescent with an oblique stigma; pod about 10 cm long, linear, sessile, 12 mm wide, flat, pubescent, containing 8-10 seeds, the latter placed transversely in the pod; seeds orbicular, brownish, 7 mm in diam.

The Yam Bean is a native of tropical America, but is now commonly cultivated in the tropics. The Chinese are the main cultivators of this species in Hawaii.

The tubers are often very large and are of the shape of a turnip.

---

*Pachyrrhizus=thick and root (Greek).

DOLICHOS Linnaeus

Calyx campanulate, with short segments, the upper united, entire or emarginate. Standard orbicular, thickened at the base and auriculate. Wings curved, obovate, adhering to the very much incurved and usually beaked keel. Upper stamen free, thickened at the base, or with appendage. Ovary subsessile, many-ovuled. Style thickened towards the apex, usually compressed, bearded on the inner side, or penicillate around the small terminal stigma. Pod linear, rarely broad oblong, very much compressed, straight or curved, usually with the thickened margins and more or less convex valves, 2-valved. Seeds thick, compressed with linear, fleshy arillus. Winding, prostrate or erect herbs or suffrutescent herbs with trifoliolate leaves, with stipellae. Flowers whitish or purplish usually in racemes.

About 30 species in the tropics of the old world; only few occur in America. *Dolichos Lablab* wild and naturalized in Hawaii.

Dolichos lablab Linn. Spec. Plant. 725. 1753.
Lablab vulgaris Savi Diss. 19. 1821.
Lablab cultratus DC. Prodr. 2:402. 1825.

Papapa bean.

Plate 93.

A stout twining perennial, glabrous; leaflets broadly triangular-ovate, 6.25-10 cm long, and nearly as broad, the lateral ones rhomboidal, obtuse or acuminate, more or less truncate at the base; flowers racemosely fascicled along a stout rhachis, white or purplish red, 12 to 14 mm long, on short pedicels; bracteoles obovate, as long as the calyx, or nearly so; lower calyx lobes broad, acute, the upper one obtuse; keel beaked; pod falciform, 7.5 to 10 cm long, 2.5 cm or less broad, flat, with an oblique or recurved joint and somewhat mucronate margins; seeds 4 or less, 10-12 mm long, subcompressed, the thick white rhaphe two-thirds the length of their diameter; seeds white of white-flowered vines, black of purple-flowered ones.

The *Papapa* bean, as the natives call this species, is a native of the old world (tropical Asia), but is now cultivated in most tropical countries. It was originally cultivated for its bean, but has now spread over all the islands. It occurs usually in the lowlands and lower hills, climbing over fences, stone walls, and trees. It is very common in the valleys back of Honolulu and also on the windward side.

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ERRATA.

Correction of scientific names:

1. Page 73, line 33—*Ceratonio*, read *Ceratonia*.
2. Page 203, line 29—*Pachyrhizus*, read *Pachyrrhizus*.
3. Page 99, line 41—Dividivi, read Divi-divi.
4. Page 204, plate 84—*Canavalia Lineata* (Thumb.) D.C., read *Canavalia Lineata* (Thun.) D.C.
5. Page 116, plate 48—Moreyton-bay Chestnut, read Moreton-bay Chestnut.

Typographical Corrections:

1. Page 21, line 15—stmens, read stamens.
2. Page 18, line 2—whenee writer, read whence writer.
3. Page 112, line 36—redpeced, read reduced.
4. Page 185, line 35—snyonymy, read synonymy.
5. Page 23, line 42—native Australia, read native of Australia.
6. Page 39, line 19—chrub, read shrub.
7. Page 43, line 20—samll, read small.
8. Page 114, line 31—Avery, read A very.

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